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EIA Report Volume I: Main Text

Mai Po Nature Reserve Infrastructure Upgrade Project

Revision 7.3 – Final
Prepared for World Wide Fund For Nature Hong Kong
20 October 2021

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Photographs

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Abbreviations

AFCD	Agriculture, Fisheries and Conservation Department
ANL	Acceptable Noise Levels
APCO	Air Pollution Control Ordinance
AQOs	Air Quality Objectives
ASR	Air Sensitive Receiver/Area Sensitivity Rating
ATC	Annual Traffic Census
BC	Barrier Correction
BMP	Best Management Practices
BMZ	Biodiversity Management Zone
BOD_5	5-day Biochemical Oxygen Demand
BSAP	Hong Kong Biodiversity Strategy and Action Plan 2016-2021
C&D	Construction and Demolition
C&DMMP	Construction and Demolition Material Management Plan
C&SD	Census and Statistics Department
CA	Conservation Area
CEDD	Civil Engineering and Development Department
CEPA	Communication, Education, Participation and Awareness
CNP	Construction Noise Permit
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CWTC	Chemical Waste Treatment Centre
DBH	Diameter at Breast Height
DC	Distance Attenuation
DEP	Director of Environmental Protection
DP	Designated Project
EA	Education Area
EcoIA	Ecological Impact Assessment
EDB	Education Bureau
EEA	Environmental and Ecological Assessment of PSFSC
EIA	Environmental Impact Assessment
EIAO	Environmental Impact Assessment Ordinance
EM&A	Environmental Monitoring and Audit
EMP	Environmental Management Plan
EP	Environmental Permit
EPD	Environmental Protection Department
ESB	EIA Study Brief
FC	Façade Correction
FEHD	Food and Environmental Hygiene Department
FSD	Fire Services Department
FSP	Fine Suspended Particulates (=$PM_{2.5}$)
G/IC	Government, Institution or Community (planning zone designation)
GLTM	Greening, Landscape and Tree Management
GRG2	Generalized Reduced Gradient
GW	Gei Wai
GW-TM	Technical Memorandum on Noise from Construction Work Other Than Percussive Piling
HKBWS	Hong Kong Bird Watching Society
HR	Haul Road
ICT	Information and Communication Technology
IND-TM	Technical Memorandum for the Assessment of Noise from Places Other Than Domestic Premises, Public Places or Construction Sites
IUCN	International Union for Conservation of Nature

LCA	Landscape Character Area
LR	Landscape Resources
MPNR	Mai Po Nature Reserve
NCO	Noise Control Ordinance
NGO	Non-Governmental Organisation
NO_2	Nitrogen Dioxide
NRMMs	Non-road Mobile Machinery
NSRs	Noise Sensitive Receivers
OI	Occurrence Index
OVTs	Old and Valuable Trees
OZP	Outline Zoning Plans
PATH	Pollutants in the Atmosphere and their Transport over Hong Kong
PFAs	Public Filling Areas
PFC	Public Fill Committee
PFRF	Public Fill Reception Facilities
PlanD	Planning Department
$PM_{2.5}$	Particulate Matter suspended in air with a nominal aerodynamic diameter of ≤2.5μm
PM_{10}	Particulate Matter suspended in air with a nominal aerodynamic diameter of ≤10μm
PME	Powered Mechanical Equipment
ProPECC PN	Professional Persons Environmental Consultative Committee Practice Notes
PSFSC	Peter Scott Field Studies Centre
RSP	Respirable Suspended Particulates (=PM_{10})
SO_2	Sulphur Dioxide
SPLs	Sound Pressure Level
SSSI	Site of Special Scientific Interest
SWLs	Sound Power Levels
TD	Transport Department
TH	Tower Hide
TIA	Traffic Impact Assessment
TIN	Total Inorganic Nitrogen
TM	Technical Memorandum
TM-DSS	Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters
TM-EIAO	Technical Memorandum on Environmental Impact Assessment Ordinance
TPB	Town Planning Board
TPU	Tertiary Planning Unit
TPZ	Tree Protection Zone
TSP	Total Suspended Particulates
VSRs	Visually Sensitive Receivers
WBTC	Works Branch Technical Circular
WCZ	Water Control Zone
WDO	Waste Disposal Ordinance
WEEE	Waste Electrical and Electronic Equipment
WMP	Waste Management Plan
WPCO	Water Pollution Control Ordinance
WQOs	Water Quality Objectives
WSRs	Water Sensitive Receivers
WWF	World Wide Fund for Nature Hong Kong
ZVI	Zone of Visual Influence

1 INTRODUCTION

1.1 Background

1.1.1 For decades, the Mai Po Nature Reserve ("MPNR") has served Hong Kong as one of the most valuable ecological assets in the city, and is managed by the World Wide Fund for Nature Hong Kong ("WWF"). Tens of thousands of visitors have shared collective memories of connecting with nature and understanding *gei wai* cultural heritage over the years. As an internationally recognized important wetland, it has also welcomed numerous local and overseas ecologists and trained wetland managers in the region.

1.1.2 Being a leading and responsible conservation and education Non-Government Organisation ("NGO"), WWF aspires to bring the outdoor nature's classroom that is MPNR to an even broader section of society, and to the Mai Po experience with the "21st Century Nature Classroom" – a first class learning environment. To realise this aspiration WWF (the Project Proponent) proposes an upgrade of key infrastructure – the Mai Po Nature Reserve Infrastructure Upgrade Project ("the Project") – that will cater for visitors, ensuring that facilities within the MPNR meet the expectations of visitors now and in the future.

1.1.3 SMEC Asia Limited ("SMEC") in association with aec Limited ("aec") have been engaged by WWF as the Project Environmental and Ecological Consultant, responsible for carrying out an Environmental Impact Assessment ("EIA") for this Project.

1.2 Designated Projects Under the EIA Ordinance

1.2.1 MPNR is located within an area zoned "Site of Special Scientific Interest" ("SSSI") on the approved Mai Po and Fairview Park Outline Zoning Plan No. S/YL-MP/6 (the OZP). Project Elements within MPNR are Designated Projects ("DPs") under Item Q.1 of Part I, Schedule 2 of the Environmental Impact Assessment Ordinance ("EIAO") as follows:

> "**All projects** including new access roads, railways, sewers, sewage treatment facilities, earthworks, dredging works and other building works **partly or wholly in an existing** or gazetted proposed country park or special area, a conservation area, an existing or gazetted proposed marine park or marine reserve, a site of cultural heritage, and a **site of special scientific interest** (SSSI) …"

1.3 Purpose and Objectives of the EIA Study

1.3.1 On 13 July 2017, a Project Profile was submitted under Section 5(1)(a) of the EIAO for application of an EIA Study Brief ("ESB"). The Environmental Protection Department ("EPD") issued ESB No. ESB-301/2017 to WWF on 25 August 2017.

1.3.2 As per the ESB, the purpose of this EIA study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the Project and associated works that will take place concurrently. This information will contribute to decisions by the Director of Environmental Protection ("DEP") on:

1. The overall acceptability of any adverse environmental consequences that are likely to arise as a result of the Project.
2. The conditions and requirements for the detailed design, construction and operation of the Project to mitigate against adverse environmental consequences wherever practicable.
3. The acceptability of residual impacts after proposed mitigation measures are implemented.

1.3.3 As per the ESB, the objectives of the EIA Study are:

1. To describe the Project and associated works together with the requirements and environmental benefits for carrying out the proposed project.

2. To identify and describe the elements of the community and environment likely to be affected by the Project and/or likely to cause adverse impacts to the Project, including both the natural and man-made environment and the associated environmental constraints.
3. To identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses.
4. To identify and quantify any potential losses or damage to flora, fauna and natural habitats.
5. To propose the provision of infrastructure or mitigation measures so as to minimise pollution, environmental disturbance and nuisance during construction and operation of the Project.
6. To investigate the feasibility, effectiveness and implications of the proposed mitigation measures.
7. To identify, predict and evaluate the residual (i.e. After practicable mitigation) environmental impacts and the cumulative effects expected to arise during the construction and operation phases of the project in relation to the sensitive receivers and potential affected uses.
8. To identify, assesses and specify methods, measures and standards to be included in the detailed design, construction and operation of the Project, which are necessary to mitigate residual environmental impacts and cumulative effects and reduce them to acceptable levels.
9. To design and specify the environmental monitoring and audit requirements.
10. To identify any additional studies necessary to implement the mitigation measures or monitoring and proposals recommended in the EIA report.

1.4 Structure of this EIA Report

1.4.1 The EIA Report is presented in five volumes. *Volume I: Main Text* is this document, and following this introductory section, the remainder of Volume I is as follows:

- **Section 2 – Description of Project.** Describes the background of MPNR, the current management of MPNR and justifies the purpose and objectives of the Project; provides details of the Project Elements initially proposed in the Project Profile, those included in the revised concept design, and finally the preferred options taken forward to schematic design, and the justifications for these changes; and discusses the background and history of the Project, including the role of the Mai Po Habitat Management Plan and the proposed construction methodology and sequence.
- **Section 3 – Air Quality Impact.** Assesses the potential air quality impact on representative Air Sensitive Receivers (ASRs) due to the construction of the Project and associated works.
- **Section 4 – Noise Impact.** Assesses potential noise impact on representative Noise Sensitive Receivers (NSRs) due to the construction of the Project and associated works (see also ***Appendix A***).
- **Section 5 – Water Quality Impact.** Assesses potential water quality impact due to the construction and operation of the Project and associated works, including but not limited to construction site drainage, discharge of stormwater, surface runoff and treated effluent generated from the facilities taking into account the cumulative impact from the existing, committed and planned projects in the vicinity of the Project (see also ***Appendix B***).
- **Section 6 – Waste Management Implications.** Assesses potential waste management implications arising from the construction and operation of the Project and associated works.
- **Section 7 – Ecological Impact.** Assesses potential ecological impact due to the Project and associated works (see also ***Appendix C***).
- **Section 8 – Fisheries Impact.** Assesses potential fisheries impact due to the Project and associated works.
- **Section 9 – Landscape and Visual Impacts.** Assessment of potential landscape and visual impacts due to the construction and operation of the Project and associated works (see also ***Appendix D***).

- **Section 10 – Environmental Monitoring and Audit (EM&A) Requirements.** Presents the recommended EM&A programme for the Project; and provides a Project Implementation Schedule (see also ***Appendix E***).
- **Section 11 – Summary Information.** Provides a summary of environmental outcomes; summary of environmental impacts; documentation of key assessment assumptions; summary of alternative options and mitigation; and documentation of public concerns (see also ***Appendices F and G***).
- **Section 12 – Conclusion.** Concludes the overall acceptability of the Project.

1.4.2 *Volume II: Figures* contains the A4-size and A3-size figures referred to in the Main Text.

1.4.3 *Volume III: Appendices* provides supplementary information as follows:

- **Appendix A – Noise Impact.** Provides supplementary information for the noise impact assessment, including background noise measurement data, photographs of NSRs, construction plant inventory and construction noise impact calculations.
- **Appendix B – Water Quality Impact.** Provides supplementary information for the water quality assessment, i.e. water quality record for gei wai.
- **Appendix C – Ecological Impact.** Lists of species recorded in MPNR – both during this study and previously by others. Species cover plants, mammals, birds (including Black-faced Spoonbill), amphibians, reptiles, odonates, butterflies, and aquatic fauna including fish.
- **Appendix D – Landscape and Visual Impact.** Provides supplementary information for the LVIA, including the Tree Preservation Application for MPNR and the phasing arrangement for construction of the tower hides and footpaths in terms of visual impact.
- **Appendix E – Project-wide Implementation Schedule.** This contains all the EIA study recommendations and mitigation measures referenced to the implementation programme.
- **Appendix F – Correspondence with the Authority.** Correspondence between SMEC/aec and relevant Authorities regarding agreement on assessment approach and parameters.
- **Appendix G – Documentation of Public Concerns.** A summary of the main concerns raised by Mai Po stakeholders, i.e. the general public, special interest groups and relevant statutory/advisory bodies as received and responded to by WWF.

1.4.4 *Volume IV: EM&A Manual* is the stand-alone EM&A Manual for the statutory EM&A programme.

1.4.5 *Volume V: Executive Summary* provides a summary of the scope and findings of the EIA Study and is presented in English and Chinese.

2 DESCRIPTION OF THE PROJECT

2.1 Purpose and Objectives of the Project

Overview

2.1.1 In 2015, WWF-Hong Kong received a grant for the proposed Project, which aims to create a 21st Century Nature Classroom that provides the facilities needed by students, teachers, public visitors, families, community groups, and those interested in wetlands research and wetlands training. This includes creating universal access to experience nature. This is in support of WWF's mission to create a future in which humans live in harmony with nature.

2.1.2 In preparing this EIA submission, WWF undertook a thorough study of the proposed design, construction and operation of the Project to mitigate against adverse environmental consequence wherever practical. This process was carried out in conjunction with Mai Po stakeholders comprised of the general public; special interest groups, in particular green groups and local villagers; and relevant statutory/advisory bodies, including EPD, the Agriculture, Fisheries and Conservation Department ("AFCD") and the Education Bureau ("EDB"), as well as the Project architects, designers and technical consultants.

2.1.3 An examination of the overall acceptability of any adverse environmental consequences likely to arise as a result of the Project, and the acceptability of residual impacts after proposed mitigation measures, resulted in an alteration of the Project Elements stated in PP-554/2017 and ESB-301/2017. This included a change to the number of Project Elements, as well as the methods, measures and standards to be included in the design, construction and operation of the Project.

2.1.4 In preparing PP-554/2017, the Project Proponent identified the most similar off-site project as the development of the Hong Kong Wetland Park, and the Project Profile "An Extension to the Existing Boardwalk and New Floating Mudflat Bird-watching Hide at Mai Po Nature Reserve for Education and Conservation Purposes" (DIR-139.2006), which was submitted for permission to apply directly for an Environmental Permit ("EP"). PP-554/2017 noted that there have been no similar works, other than the boardwalk extension and floating mudflat bird hide, carried out in the vicinity of or with MPNR since it was originally established.

2.1.5 Like the Hong Kong Wetland Park, MPNR is a landmark in wetland conservation education, indeed, as mentioned in AFCD's *Mai Po Inner Deep Bay Ramsar Site Management Plan 2011*, both the Hong Kong Wetland Park and MPNR serve the Ramsar Communication, Education, Participation and Awareness ("CEPA") programme for different target visitors. Hong Kong Wetland Park and MPNR will continue their roles to complement each other in the CEPA implementation of the Ramsar Convention in Hong Kong.

2.1.6 As outlined in AFCD's *Mai Po Inner Deep Bay Ramsar Site Management Plan 2011*, the CEPA programme for MPNR offers various educational walks, special tours, and workshops to the general public. Since 1991, WWF has organized the Wetland Management Training Programme at the MPNR for wetland managers and decision makers, who are responsible for the management and conservation of wetlands in the East Asian-Australasian Flyway for migratory waterbirds.

2.1.7 While the CEPA activities of MPNR and the Hong Kong Wetland Park are complementary, the link between the proposed infrastructure upgrade at MPNR, and the 10,000m^2 visitor centre at Hong Kong Wetland Park, is no longer pertinent given the reduced number of Project Elements and the adjustments to the design, the construction and operation methods, following the advice of Mai Po stakeholders.

2.1.8 In fact, the reduced scope of the Project has highlighted its similarity to the regular infrastructure work carried out under the *Mai Po Habitat Management Plan 2019-2024* and the boardwalk extension and new floating mudflat hide constructed at MPNR in 2006, for which permission to apply directly for an EP was given.

2.1.9 As the city's leading NGO, WWF plays an important role in ensuring that the public is aware of biodiversity and its values by supporting community education and working with partner networks and organisations. In proposing this infrastructure upgrade, WWF is aligning its goals with key actions set out in the government's Biodiversity Strategy and Action Plan ("BSAP") and Aichi Biodiversity Target 1.

2.1.10 BSAP Action 20b aims to "promote awareness and community involvement through citizen science monitoring programmes," Action 21b aims to "engage NGOs to provide capacity building for teachers on biodiversity" and 21c aims to "engage the resources for early childhood education on nature conservation".

2.1.11 Aichi Target 1 states, "By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably". The zero draft of the post-2020 global biodiversity framework was released on 13 January 2020. The draft noted that a post-2020 framework should be accompanied by an inspirational and motivating 2030 mission as a stepping stone towards the 2050 Vision of "Living in Harmony with Nature", and that it should be supported by a comprehensive and innovative communication strategy.

2.1.12 Visitor to MPNR enter on permits issued by AFCD and AFCD has supplied WWF with permits for 365 people. Visits organised by WWF are all guided by WWF staff who ensure that visitors follow the visitor guidelines. Public visits to MPNR began in 1985. By the early 1990s, visitor numbers were in excess of 35,000 per year, hitting a peak of over 45,000 in 2002, and stabilising at around 40,000 per year for the remainder of that decade. These figures are based on records from Mai Po Inner Deep Bay Ramsar Site Management Plan. Due to the commencement of operations at Hong Kong Wetland Park, the number of visitors to MPNR dropped to 24,000 per year. The Project Proponent targets 32,000 visitors per year by 3 years after the completion of the build, which is less than the number that visited Mai Po during its peak.

2.1.13 Mai Po has left an indelible impact on a wide range of people, from students and researchers to birdwatchers. They come to Mai Po to discover Hong Kong's rich local biodiversity, the latest scientific research methods and to learn about conservation. At MPNR our community can "Connect with Nature" to better understand the need to protect wetlands and biodiversity.

2.1.14 The Project aims to highlight to all visitors the beauty and importance of nature in their own lives. Visitors can discover biodiversity year-round, have opportunities to observe the reserve's bird life, and connect to nature. For more than three decades, the biodiversity of over 2,050 species at MPNR has served to educate and enlighten Hong Kongers from all walks of life.

With the Project in Place

2.1.15 The Project will facilitate universal access and provision of new educational components through the provision of two new Tower Hides and the replacement of the existing footpaths with boardwalks. The Mai Po Education Centre will also be refurbished internally for safe and flexible provision for public education programme. With enhancement of the hardware of the public education programme, the software/ programming can be further developed and diversified for the general public.

2.1.16 In other words, the Project will provide opportunities to empower people from different backgrounds and sectors of society with important knowledge about wetland and environmental protection and sustainable development in a unique natural setting. In doing so, the Project will also help government achieve some of the actions set out in BSAP.

Without the Project in Place

2.1.17 If the Project does not go ahead, MPNR will be left with its existing aging infrastructure – some of it more than 30 years old – that cannot cope with the demands of the community; WWF will not be able to help government achieve BSAP Actions 21b and 21c; it will remain difficult to monitor the southern part of MPNR; and WWF will not be able to realise their aspirations to transform Mai Po into a first class learning institute.

2.1.18 Furthermore, organisations that use MPNR, such as the Hong Kong Bird Watching Society (HKBWS), will not be able to benefit from the provision of the new Tower Hides.

2.2 Details of the Project

Location

2.2.1 MPNR is located in Yuen Long District in the north of Hong Kong. Within Yuen Long District is the 1,540ha Mai Po Inner Deep Bay Ramsar Site. This was recognised in 1995 as a "Wetland of International Importance" and acts as a key way station and wintering site along the East Asian-Australasian Flyway through which 50 million migratory water birds travel each year.

2.2.2 Within the Ramsar Site is the 427.5ha Mai Po Marshes SSSI. This comprises 372.1ha zoned as "SSSI" (Tai Long Kei and Shek Shan) and 55.4ha zoned as "SSSI(1)" (Lut Chau) on the approved Mai Po and Fairview Park Outline Zoning Plan (OZP) No. S/YL-MP/6, which was gazetted on 18 February 2005.

2.2.3 Within the Mai Po Marshes SSSI is the 372.1ha MPNR (corresponding to the "SSSI" (Tai Long Kei and Shek Shan) zone) and within MPNR is the 211.7ha Project Site, which is land leased by WWF from government.

2.2.4 To the east and south of the Project Site there is an area zoned "Conservation Area" (CA) on the OZP, in which there are a number of fish farms and abandoned fish ponds. The planning intention of the "CA" zone is to conserve the ecological value of wetland and fishponds. Outside the "CA" zone to the southeast of the Project Site lies the Fairview Park residential development. To the south of the Site, at Lut Chau, there are more fishponds located in an area zoned "SSSI(1)" on the OZP. The northern and western boundary of the Project Site abut the Frontier Closed Area Boundary (boundary road and fence), beyond which are mangroves and then Deep Bay.

2.2.5 The Project Site and its environs are shown on ***Figure 2-1***.

Project Elements

2.2.6 Project Profile No. PP-554/2017 and the ESB covered the construction and operation of one or more of the following Project Elements and associated works, such as upgrading of existing access tracks/bunds:

1. Refurbishment of the Mai Po Education Centre ("MPEC")
2. Widening of the existing footpath ("New Boardwalk")
3. Construction of new Tower Hide ("TH2")
4. Expansion of existing Tower Hide ("TH1")
5. Construction of new Tower Hide ("TH1E")
6. Construction of new "Circular Route" footpath

2.2.7 For a variety of reasons, three of the above Elements have been removed from the Project; two carried forward with adjustments; and one carried forward without adjustments, as shown on ***Figure 2-2***. A description of the Project Elements and the reasons for adjustments, is given below.

Refurbishment of Mai Po Education Centre (MPEC)

2.2.8 **This Element has been removed from the Project.** While the MPEC building structure is sound, the facilities it offers are no longer considered to be adequate. It was intended to comprise internal refurbishment and the upgrade of Fire Services installations, which included structural works with a water tank and pump room adjacent to the MPEC. The Project Proponent has resolved to only move forward with an internal renovation of the facilities, requiring no structural works adequate for use of the area for educational purposes, both by schools and public.

Widening of the Existing Footpath (New Boardwalk)

2.2.9 **This Element remains in the Project, with adjustments.** The concrete footpath running between the MPNR entrance and the MPEC to the existing TH1 and the new TH3 (formerly referred to as "TH1E") is in a poor state of repair, cracked and in some places subsiding, making passage challenging for some visitors. Currently, when visitors encounter other groups, or stop to watch birds or wildlife, there is no space for others to pass, forcing visitors to step off the path. This is particularly problematic for wheelchair users. Additionally, there are no safety features to prevent wheelchairs from going off the path. The original intention was to break up and remove the old concrete footpath, laying a new concrete path in its place. The new path was designed to provide universal access, with six Education Areas ("EAs") utilising interactive materials. The plan also made provision for seven wheelchair passing bays. The shape of the concrete path was designed to not affect adjacent trees or their roots. Any concrete footpath, however, may result in fragmentation of habitat for reptiles and small mammals. As such, the design was reconceived as a raised wooden boardwalk over the original concrete path. The raised wooden boardwalk design, including the six interactive EAs and seven passing bays, as shown on ***Figure 2-3***, ensures no fragmentation of habitat and fully meets the needs for visitors, researchers, and for educational purposes.

Construction of New Tower Hide (TH2)

2.2.10 **This Element remains in the Project.** As a feature of the infrastructure upgrade, the Project Proponent recognised the need for more than one tower hide, in appropriate locations, to accommodate the different needs of researchers, school groups and public visitors. The increase in elevation that a tower hide affords, not only gives a view over a greater area of habitat than a one-storey hide, but provides occlusion for a larger part of the reserve. As shown on ***Figure 2-4***, TH2 is planned to be built on the bund between gei wai 19/20, facing towards gei wai 20e, for research work.

2.2.11 TH2 is a new three-storey tower hide, modelled on the design of the existing TH1 at gei wai 8 and hence will be of the same height. Photo of the existing TH1 is shown in ***Photograph 2-1***, below, for reference. TH2 is essentially a 7.9m three storey, metal-framed structure, clad in "Onduline" (a brand of lightweight roofing and cladding material) for water proofing. Some internal components such as window frames, and floors will be made of wood coated in fire retardant paint. The Onduline roof will further be overlaid with racks that support solar panels, which will take the height of TH2 to 8.4m. Batteries on the ground floor will store electricity that will be used to power minimal floor lighting, internal fans and WiFi. No toilets or washrooms will be provided.

2.2.12 This area of the reserve is of particular value for the observation of raptors in MPNR and required a hide of several storeys. This area is generally off-limits to public and school visitors, and is primarily used for research purposes. Previously, there was a temporary two-storey tower hide at this location, facing gei wai 23. This tower hide was removed as it became dilapidated, but one is needed by the research team to fulfil the requirements of *Mai Po Inner Deep Bay Ramsar Site Management Plan*. This area in the south of the reserve is ideal for research on waterbirds that utilise rain-fed ponds, open-water gei wai, and reedbeds. Researchers should be able to use bird hides, reducing disruption to wildlife. The location was selected to meet research needs, and the hide is designed to have no effect on species, particularly trees or their roots. The work will also involve constructing an access path leading towards the hide from bund between gei wai 18/19. The access path will be a raised wooden boardwalk, similar to the "new boardwalk" described above, which will preventing any habitat fragmentation for reptiles and small mammals. Visitors could reach this access path from the entrance of MPNR along the "new boardwalk" and the existing bund between gei wai 18/19 that no additional boardwalk would be required other than this access path.

Photograph 2-1 Existing Tower Hide 1



Expansion of Existing Tower Hide (TH1)

2.2.13 **This Element has been removed from the Project.** TH1 is an existing tower hide located at gei wai 8a. The tower hide was intended to be partially demolished and extended in order to facilitate separate groups of public, school visitors, and researchers. Researchers have greater space needs due to their extensive equipment, and on average they utilise the hides for a longer period of time than school and public visitor groups. The Project Proponent wants to ensure that research work can continue in hides undisturbed, while also raising public awareness and education of the importance of wetlands and their conservation. The tower hide was planned as a three-storey structure expansion. It was found that to provide the expansion the footing may cause an adverse impact on nearby trees and roots, and therefore the Project Proponent did not proceed with this element. Instead, a new location near to gei wai 8a was conceived where such impacts could be avoided, to be delivered as TH1E.

Construction of New Tower Hide (TH3, formerly TH1E)

2.2.14 **This Element remains in the Project, with some adjustments and has been renamed TH3.** It is a new three-storey tower hide that follows the same design as the new TH2, discussed above. TH3 is planned to be built on the bund between gei wais 7 and 8, facing towards gei wai 8a, as shown on ***Figure 2-5***. The area to the west of TH3 is ideal for viewing and learning about waterbirds that utilise rain-fed ponds, open-water gei wai, and reedbeds. The Project Proponent has designed the location of the hide to ensure that visitors are occluded on the reserve as much as possible when stopping to view waterbirds. As such, public and students will use bird hides wherever possible. The location and construction of the hide is designed to have no effect on trees or their roots. The work will also involve constructing an access path leading towards TH3 from bund #9. The access path will be a raised wooden boardwalk, similar to the "new boardwalk" described above, which will prevent any habitat fragmentation for reptiles and small mammals. Following the construction of TH3, there will be two tower hides in this location. They are the closest hides to the entrance of the reserve. The Project Proponent plans to further implement the strategy of facilitating separate groups of public, school visitors, and researchers.

Construction of New "Circular Route" Footpath

2.2.15 **This Element has been removed from the Project.** The "circular route" footpath was conceived to provide alternative access to TH3, and for shorter visits to the reserve. It was planned to run roughly parallel with the AFCD footpath. This element was removed from the project due to concerns over concrete mixing and loss of habitat.

Update to Project Elements after Stakeholder Views

2.2.16 Since the Project initiation document in 2015, WWF has conducted a series of consultations with Mai Po stakeholders comprising the general public; special interest groups, in particular green groups and local villagers; and relevant statutory/advisory bodies, including EPD, AFCD and EDB.

2.2.17 The Project Elements as outlined above (and in PP-554/2017 and ESB-301/2017) have undergone revisions based on feedback received in our consultations, and have been reduced to just three Elements. Two of those Elements have also been further adjusted based on the feedback WWF received from stakeholders. See ***Table 2-1***, below, for details.

2.2.18 The six Project Elements described in PP-554/2017 and ESB-301/2017, comprising work on three tower hides, two footpaths, and a refurbishment of MPEC, have been reduced to just three Elements with adjustments, comprising work on two tower hides and one footpath, following consultation meetings.

2.2.19 As outlined in ***Table 2-1***, below, stakeholder views provided a good level of input on Project Elements that can be delivered with a greater acceptability of any adverse environmental and residual impacts.

Consideration of Development Options

2.2.20 Since the issue of the Project Profile (i.e. the initial development option) in 2017, the Project Elements have moved to concept design (i.e. the revised development option) and to schematic design (i.e. the preferred development option), taking into account environmental impacts relating to air quality, noise, water quality, waste management, ecology, fisheries and landscape and visual impact. ***Table 2-2***, below, summarises how these potential environmental impacts shaped and improved upon the design of the original Project Elements.

Table 2-1 Update to Project Elements after Stakeholder Views

<table>
<tr><th></th><th>REFURBISHMENT OF MPEC</th><th>WIDENING OF EXISTING FOOTPATH (NEW BOARDWALK)</th><th>CONSTRUCTION OF NEW TOWER HIDE (TH2)</th><th>EXPANSION OF EXISTING TOWER HIDE (TH1)</th><th>CONSTRUCTION OF NEW TOWER HIDE (TH3)</th><th>CONSTRUCTION OF NEW “CIRCULAR ROUTE” PATH</th></tr>
<tr><td>SITING</td><td>Concerns over the extent of structural changes at MPEC led to removal of project element and internal renovation only.</td><td>No comments from stakeholders requiring update to element.</td><td>Concerns over disruption to wildlife led to decision to build tower hide. This tower hide best meets raptor and south reserve research requirements.</td><td rowspan="6">Concerns over impact on tree roots led to a decision to remove project element.</td><td>Concerns over disruption to wildlife led to decision to build tower hide. This tower hide best meets public and school education requirements.</td><td>Concerns over loss of habitat due to location of footing on “mangrove islands” led to decision to remove project element.</td></tr>
<tr><td>ALIGNMENT</td><td>No comments from stakeholders requiring update to element.</td><td>Concerns over impact on tree roots led to a change in alignment of footpath. Concerns over habitat fragmentation led to raised boardwalk design.</td><td>No comments from stakeholders requiring update to element.</td><td>Concerns over impact on tree roots led to a change in alignment of footpath and ramp.</td><td>No comments from stakeholders requiring update to element.</td></tr>
<tr><td>SIZE</td><td rowspan="3">Concerns over the extent of structural changes at MPEC led to removal of project element and internal renovation only.</td><td>Concerns over impact on trees/roots led to widening only for accessibility, EAs and passing bays, without impact to trees.</td><td rowspan="2">Concerns over the visual impact of a 4-storey tower hide led decision to only building 3-storeys Concerns over habitat fragmentation led to raised boardwalk design.</td><td>Concerns over the visual impact of a 4-storey tower hide led decision to only building 3-storeys.</td><td>Concerns over loss of habitat due to location of footing on “mangrove islands” led to decision to remove project element.</td></tr>
<tr><td>DESIGN</td><td>Concerns over the fragmentation of habitat led to a boardwalk design 6cm above the old footpath.</td><td>Concerns over impact on tree roots led to a change in alignment of footpath and ramp. Concerns over habitat fragmentation led to raised boardwalk design.</td><td>Concerns over use of concrete and footing on “mangrove islands” led to decision to remove project element.</td></tr>
<tr><td>CONSTRUCTION METHODS</td><td rowspan="2">Concerns over concrete mixing and concrete dust generation from breaking up the old path led to the decision to create a wooden structure above old footpath made from element fabricated off-site.</td><td rowspan="2">Concerns over onsite concrete mixing led to decision to conduct off-site concrete mixing and prefabrication of elements.</td><td>No comments from stakeholders requiring update to element.</td><td>Concerns over concrete mixing led to decision to remove project element.</td></tr>
<tr><td>SEQUENCE OF CONSTRUCTION</td><td>No comments from stakeholders requiring update to element.</td><td>Concerns over onsite concrete mixing led to decision to conduct off-site concrete mixing and prefabrication of elements.</td><td>No comments from stakeholders requiring update to element.</td></tr>
<tr><td>ACCESS ARRANGEMENT</td><td>No comments from stakeholders requiring update to element.</td><td>No comments from stakeholders requiring update to element.</td><td>No comments from stakeholders requiring update to element.</td><td>No comments from stakeholders requiring update to element.</td><td>Concerns over impact on tree roots led to a change in alignment of footpath and ramp.</td><td>No comments from stakeholders requiring update to element.</td></tr>
<tr><td>OUTCOME</td><td>PROJECT ELEMENT REMOVED</td><td>PROJECT ELEMENT RETAINED</td><td>PROJECT ELEMENT RETAINED</td><td>PROJECT ELEMENT REMOVED</td><td>PROJECT ELEMENT RETAINED</td><td>PROJECT ELEMENT REMOVED</td></tr>
</table>

Table 2-2 Consideration of Environmental Impact of Development Options and Resulting Changes to Project Elements

PROJECT COMPONENTS / CRITERION	DEVELOPMENT OPTIONS AND ENVIRONMENTAL IMPACT		
	INITIAL (PROJECT PROFILE)	REVISED (CONCEPT DESIGN)	PREFERRED (THE PROJECT) (SCHEMATIC DESIGN)
	EXTERNAL WATER TANK STRUCTURE AT MPEC; 3-STOREY TH2; EXPANSION OF TH1; CONCRETE "CIRCULAR ROUTE"; CONCRETE FOOTPATH EXTENSIONS	EXTERNAL WATER TANK STRUCTURE AT MPEC; 4-STOREY TH2; EXPANSION OF TH1; PREFABRICATED RC SLAB "CIRCULAR ROUTE" AND FOOTPATH EXTENSIONS	3-STOREY TH2 AND TH3; WOODEN BOARDWALKS OVER EXISTING FOOTPATH WITH EXTENSION TO NEW HIDES
AIR	Dust from breaking concrete footpath, and on-site construction of tower hides, and vehicle and dust emissions resulting from vehicle movements transporting heavy construction materials.	Leaving existing concrete paths in situ, and off-site fabrication of footpath and tower hides, as far as possible, to reduce on-site dust generation and vehicle emissions.	Wooden boardwalk above concrete footpaths and assembly on-site with manual labour, plus off-site concrete mixing for tower hide foundations, and off-site prefabrication of steel/wood structures, minimises dust and vehicle emissions.
NOISE	Noise from PME used for breaking concrete footpath, on-site construction of tower hides, and vehicle movements transporting heavy construction materials.	No PME required for concrete removal, off-site fabrication of footpath sections and tower hides, and off-site concrete mixing, reduces noise and onsite construction. Transportation of heavy construction materials remains.	Wooden boardwalk above concrete footpaths and fewer tower hide sections assembled with manual labour on site, reduces the need for PME and minimises noise. Transportation of heavy construction from site is significantly reduced.
WATER	Potential runoff in the event of cement mixing on-site reaching gei wai and local water courses.	Off-site concrete mixing minimises concrete runoff.	Off-site pre-fabrication, off-site concrete mixing, and reduced tower hide materials, further minimises runoff.
WASTE	Significant quantity of waste concrete from removal of footpath and from on-site construction. Some waste incurred from tower hide extension.	Less waste from on-site construction due to off-site pre-fabrication, but still waste from existing concrete footpath removal. Minimal waste from new tower hides approach, i.e. building the new TH3 instead of partially demolishing and extending the existing TH1.	Minimum waste generation as no concrete waste from footpath removal. Minimal waste from new tower hide construction approach, i.e. building the new TH3 instead of partially demolishing and extending the existing TH1.
ECOLOGY	Loss of bund vegetation due to "Circular Route" concrete path, widening of existing concrete paths, and damage to tree roots from TH1 extension. TH2 no such concerns, with no impact to trees or roots.	"Circular Route" and existing concrete footpaths improved as wooden boardwalk, however, concerns over some loss of wetland for "Circular Route", and damage to tree roots from TH1 extension. TH2 no such concerns, with no impact to trees or roots.	"Circular Route" route not pursued. TH1 extension replaced by TH3, which is a three-story hide with reduced ramp length with no impact to trees or roots. TH2 no such concerns, of similar design, with no impact to trees or roots.
FISHERIES	Potential runoff to adjacent fish ponds due to breaking main concrete footpath that runs alongside, and cement mixing on-site.	Off-site cement mixing minimises concrete runoff to adjacent fishponds.	Wooden boardwalk situated above concrete path eliminates risk of concrete runoff.
LANDSCAPE & VISUAL	New external water tank structure at MPEC, 3-storey TH2, Expansion of TH1 and the concrete "Circular Route" will have limited visual impact.	New external water tank structure at MPEC, 4-storey TH2, expansion of TH1 will have limited visual impact, but less for boardwalk "Circular Route".	No impact from MPEC external works or "Circular Route" as not pursued. 3-storey TH2; TH3; wooden boardwalks over existing footpath with extension to new hides is visually in keeping with the nature reserve's setting.

Key: Severe Impact High Impact Moderate Impact Low/Negligible Impact

Construction of the Project

2.2.21 A site hoarding/fencing will be erected, likely light fencing, subject to Buildings Department ("BD") requirements, and adjusted to the size of works area.

2.2.22 A detailed plant inventory showing the types and quantities of Powered Mechanical Equipment ("PME") to be used during construction is discussed in ***Section 4***. The speed of construction vehicles within the Project Site will be limited to 20km/h to minimise noise and dust emission.

Tower Hides

2.2.23 The construction of TH2 and TH3 will be in two phases; Phase 1 for footings, to be carried out from mid April to mid May 2022; and while Phase 2 for superstructure, to be carried out from September to mid October in 2022. The works will comprise the following:

1. Phase 1 – Construction of Footings:
    a. MPNR staff temporarily lower (draw-down) the water level in gei wais 7, 8a, 19 and 20e in accordance with the latest *Mai Po Management Plan 2019-2024*
    b. Excavate to the required level
    c. Off-site prefabrication of Reinforced Concrete ("RC") footing
    d. Lay blinding layer at excavation level
    e. Erect timber formwork shutter to the footing
    f. Rebar fixing work to the footing with starter bars for columns and walls
    g. Construction of substructure
    h. Rebar fixing to stud walls/columns
    i. Timber formwork erection to stud walls/columns
    j. Concreting to stud walls/columns and allow it to cure
    k. Backfill footing with soil
2. Phase 2 – Construction of Superstructure:
    a. Install steel column, beams and bracing between G/F and 1/F by pulley
    b. Repeat above to build up steel main structure up to roof level
    c. Installation of floors, stairway, and façade and other necessary components, e.g. handrails, wooden chairs, windows and doors, and equipment
    d. Apply intumescent paint to steelwork and woodwork
    e. MPNR staff raise the water level in gei wais 7, 8a, 19 and 20e back to the original level in accordance with the latest *Mai Po Management Plan 2019-2024*

2.2.24 For TH2, construction of footings will require a works area of 835m^2 and construction of superstructure will require a works area of 355m^2. For TH3, construction of footings will require a works area of 940m^2 and construction of superstructure will require a works area of 350m^2. For both tower hides, the works area is assumed to be cleared bare ground, which could be a potential source of dust and also of muddy runoff during rainstorms.

Boardwalk and EAs

2.2.25 The new boardwalk will be around 1.65m wide. The boardwalk for the Main Footpath (921m-long) and for Access to TH1 (66m-long) will be constructed above the existing 1.5m-wide concrete footpath, which will not be removed. The boardwalk for Access to TH2 (156m-long), for Access to TH3 (85m-long) and for the EAs (various dimensions) will be constructed above natural ground.

2.2.26 Construction of the boardwalks will be carried out in sections, each up to 100m in length. The works will comprise the following:

1. Lay pre-fabricated wooden decking sections over existing concrete footpath at 2m spacing either side of the new footpath alignment, with sections for EAs and passing bays
2. Connect horizontal bracing between sections
3. Bolt the pre-fabricated wooden decking sections onto the horizontal bracing

2.2.27 The new boardwalk is intended to be installed in three phases to minimise impacts to visitors and maximise access to the reserve and MPEC through diversions. Each phase will take roughly three weeks to complete and the works will start from MPNR entrance towards MPEC. The phased construction traffic and visitor routes during construction and thereafter are shown schematically in ***Appendix D2***.

2.2.28 For the Main Footpath and the Accesses to TH1, TH2 and TH3, the works area will include the 1.65m-wide boardwalk plus up to 1.5m on each side, i.e. 1.5m + 1.65m + 1.5m = 4.65m wide. As the boardwalk will be constructed in 100m lengths, the maximum works area at any one time will be 4.65m x 100m = 465m^2.

2.2.29 The Main Footpath and Access to TH1 boardwalks will be constructed above the existing 1.5m-wide concrete footpath, which is not considered to be bare ground. Therefore, for the Main Footpath and Access to TH1, the area of bare ground will be smaller than the works area. For a typical 4.65m width of works area, 1.5m will be the existing concrete path, and 3.15m will be cleared bare ground on each side. So, for a typical 100m length, of the 465m^2 works area, 1.5m x 100m = 150m^2 will be the existing concrete footpath and 3.15m x 100m = 315m^2 will be cleared bare ground. For the Accesses to TH2 and TH3 there is no existing concrete footpath, and therefore all of the 465m^2 works area is assumed to be cleared bare ground.

2.2.30 For construction of the six EAs along the Main Footpath, the works area will be up to 2m on each side (except the side that abuts the boardwalk of the Main Footpath, which is counted as part of the Main Footpath works area). The total works area will be 299m^2, all of which is assumed to be cleared bare ground. The largest EA will have a works area of 53.2m^2 and will be constructed next to a 100m section of new boardwalk above the main footpath, which would have cleared bare ground of 315m^2, giving a maximum combined area of cleared bare ground of 353.2m^2, which is less than that for a 100m section of boardwalk.

2.2.31 Bare ground could be a potential source of dust and also of muddy runoff during rainstorms. ***Table 2-3***, below, and ***Figure 2-3***, summarise the boardwalk areas, the works areas and the bare ground areas for the boardwalks and EAs. The total area of bare ground cleared for boardwalk construction will be 4,529.2m^2. However, as only up to 100m length of boardwalk will be installed at a time, the maximum area of bare ground at any one time due to boardwalk installation is only 465m^2.

Table 2-3 Bare Ground Area Cleared for Boardwalk Construction

DESCRIPTION	BOARDWALK AREA			WORKS AREA			BARE GROUND AREA		
	LENGTH (m)	WIDTH (m)	AREA (m^2)	LENGTH (m)	WIDTH (m)	AREA (m^2)	LENGTH (m)	WIDTH (m)	AREA (m^2)
CONSTRUCTION OF NEW BOARDWALKS ABOVE EXISTING FOOTPATHS									
Main Footpath	921.0	1.65	1,519.7	921.0	4.65	4282.65	921.0	3.15#	2,901.2
Access to TH1	66.0	1.65	108.9	66.0	4.65	306.9	66.0	3.15#	207.9
			1,628.6			**4,589.6**			**3,109.1**
CONSTRUCTION OF NEW BOARDWALKS TO ACCESS NEW TOWER HIDES									
Access to TH2	156.0	1.65	257.4	156.0	4.65	725.4	156.0	4.65	725.4
Access to TH3	85.0	1.65	140.3	85.0	4.65	395.3	85.0	4.65	395.3
			397.7			**1,120.7**			**1,120.7**
CONSTRUCTION OF NEW BOARDWALKS FOR EAs									
EA No. 1*	2.0 + 3.8	1.8 + 1.8	3.6 + 6.8	6.0 + 7.8	3.8 + 3.8	22.8 + 29.6	6.0 + 7.8	3.8 + 3.8	22.8 + 29.6
EA No. 2	10.0	1.8	18.0	14.0	3.8	53.2	14.0	3.8	53.2
EA No. 3	4.4	1.0	4.4	8.4	3.0	25.2	8.4	3.0	25.2
EA No. 4*	3.2 + 4.8	1.8 + 1.8	5.8 + 8.6	7.2 + 8.8	3.8 + 3.8	27.4 + 33.4	7.2 + 8.8	3.8 + 3.8	27.4 + 33.4
EA No. 5	8.0	1.8	14.4	12.0	3.8	45.6	12.0	3.8	45.6
EA No. 6*	1.4 + 4.9	3.5 + 1.7	4.9 + 8.3	5.4 + 8.9	5.5 + 3.7	29.7 + 32.5	5.4 + 8.9	5.5 + 3.7	29.7 + 32.5
			74.6			**299.4**			**299.4**
	TOTAL BOARDWALK AREA		2,100.9	TOTAL WORKS AREA		6,009.7	TOTAL BARE GROUND AREA		4,529.2

Notes:

For Construction of New Boardwalks Above Existing Footpaths, since there is an existing 1.5m wide concrete footpaths that will not be removed and does not count as bare ground, the width of bare ground area is therefore 4.65m - 1.5m = 3.15m. Thus, the works area for the Main Footpath is 4,282.65m^2 and for the Access to TH1 is 306.9m^2, but the bare ground area is 2,901.2m^2 and 207.9m^2, respectively, the difference being the area of the existing 1.5m wide concrete path.

* These EAs comprise two sections, each shown separately.

Operation of the Project

2.2.32 Visits organised by WWF are all guided by WWF staff who ensure that visitors act responsibly. Tower hides and footpaths are screened to keep human disturbance to a minimum. With these measures in place wildlife has, to some extent, become used to human presence within MPNR but there is, nevertheless, an unavoidable impact caused by human presence.

2.2.33 The impact caused by human presence within MPNR is not simply to do with the number of visitors, but also where they go and how long they remain within MPNR. In 2016 there were approximately 24,100 visitors. The existing facilities within MPNR – MPEC, TH1, various footpaths, boardwalks and bird hides – mean that visitors spent on average around four hours within MPNR, concentrated at these few facilities.

2.2.34 Visitor-hours is considered to be a more holistic measure than visitor numbers, since this accounts for the time visitors spend in MPEC. In 2016 there were 96,400 visitor-hours in MPNR, or around 264 visitor-hours per day on average.

2.2.35 The Applicant anticipates an increase of 36% in visitor numbers by three years after the Project is completed, equivalent to 32,800 visitors per year. However, with the provision of additional facilities such as TH2, TH3, and improved indoor space at MPEC (from internal refurbishment), the average duration of a visit will reduce from four hours to three hours or less and visitors will spend less time moving around within MPNR. In terms of visitor-hours, this equates to 98,400 visitor-hours per year, or around 270 visitor-hours per day – an increase of just 6 visitor-hours per day compared to the present. Furthermore, human presence with MPNR will be less concentrated along the main footpath, MPEC and TH1 because TH2 and TH3 will also be available to absorb visitors over a larger area of MPNR.

2.2.36 The new tower hides and associated access paths will be screened, as in the existing practice, to keep human disturbance to a minimum. Based on a negligible (2%) increase in daily visitor-hours coupled with a lower concentration of visitors at key locations within MPNR, it is considered that the Project will not lead to any noticeable increase in environmental impact due to human presence when compared to the current situation.

2.2.37 The increase in visitor numbers can be handled within the existing quota of visitors permitted by AFCD and there is no intention to ask AFCD for any additional permits.

2.2.38 Overall, therefore, once the Project has been completed, there are not expected to be any additional impacts resulting from the visitors' use of the upgraded and new facilities.

Project Programme

2.2.39 November to March is the dry season and the most ecologically sensitive period within MPNR when there are a high number of migratory water birds resident that may be susceptible to outdoor construction work, particularly noise. Therefore, no noisy outdoor construction work shall be permitted during this period. As a further precaution, a two-week buffer will also be included before the start and after the end of this period. Thus, no noisy outdoor construction work shall be permitted from mid-October to mid-April.

2.2.40 The construction programme for TH2 and TH3 is based around the planned drain-down of adjacent gei wai as stipulated in the *MPNR Management Plan*. These planned drain-downs are not specifically for the construction of TH2 and TH3 and would have occurred with or without the Project. As such, these drain-downs do not form part of the works for TH2 and TH3, which are merely making use of the fortuitous timing of the drain-down of adjacent gei wai. Details of the *MPNR Management Plan* are provided in ***Section 2.3***.

2.2.41 ***Figure 2-6*** shows the works for the Project commencing in April 2022, after completion of the planned drain down of gei wai for 2022 under the *MPNR Management Plan*. This means that the construction of the Project will not be concurrent with planned maintenance works. In mid-May 2022 the Project works will stop for the habitat management and planned gei wai refill under the *MPNR Management Plan* and recommence in early-September 2022 for completion in mid-October 2022.

2.2.42 The demolition and rebuild of PSFSC near MPNR will have been completed by March 2022 whereas the construction of this Project will not commence until end-April 2022. As such, the demolition and rebuild of PSFSC will not be carried out concurrently with this Project and so there will be no cumulative impacts for these two projects.

2.3 Background and History of the Project

History of Mai Po

2.3.1 "Gei Wai" is a technique to rear shrimp in inter-tidal areas. Shrimp ponds – gei wai – were first constructed around 1940-1945, when immigrants from China settled in the Deep Bay area and brought this farming technique with them. Located where inter-tidal marshes and mangroves occur, the original construction of gei wai required significant alteration of the natural mangrove environment that existed at that time. Details of gei wai operation can be found in *Historical Management Practices of the Mai Po Gei Wai*[Ref.#1].

2.3.2 The gei wai at Mai Po are of great cultural significance as they are the only remaining examples in Hong Kong. They are also one of the few traditionally (extensively) managed shrimp ponds that remain in Asia, and are increasingly being seen as an example of the "wise use" of wetlands, as gei wai operators utilise natural resources sustainably as livelihood without exhausting them, and at the same time benefiting the wildlife without posing impact on the natural environment.

2.3.3 History of Mai Po Marshes Nature Reserve started in 1982, the Hong Kong Government's Executive Council approved WWF's request for permission to develop a nature reserve at MPNR. On 2 September 1983, WWF was given its first license from the government for a portion of land at MPNR next to Pond #15b for the purpose of erecting a small visitor centre, which was later converted into a bird ringing station following construction of the Mai Po Marshes Wildlife Education Centre (i.e. MPEC) in 1986.

2.3.4 In the intervening years, MPNR further developed its education and training programmes, alongside habitat management and research. Between 1983 and 1995, WWF obtained licenses for 24 gei wai. In relation to this Project, WWF has the licenses for gei wai 8a and #20e.

2.3.5 WWF currently manages and maintains 211.7ha of the 372.1ha MPNR, as well as a 45ha extent of mudflat in the Inner Deep Bay. It is important to understand that while MPNR is an ecologically sensitive area, it is not a pristine wilderness. It is a modified and actively managed environment.

The Mai Po Habitat Management Plan

2.3.6 MPNR is actively managed by WWF to meet specific goals that are set out in the *Mai Po Nature Reserve Habitat Management, Monitoring and Research Plan* ("the MPNR Management Plan"), which is prepared according to the objectives and restrictions of the management zones of the Ramsar site and covers a five years period. The current version is the *MPNR Management Plan 2019-2024*[Ref.#2]. In carrying out its management of MPNR, WWF is advised by the Mai Po Management Committee – the most knowledgeable group of experts advising on the management of MPNR – whose members include representatives from AFCD and HKBWS together with independent wetlands and water birds experts.

2.3.7 The development and management of MPNR was established in 1983 with four aims:

1. Maintain, and if possible, increase the diversity of native wildlife in the area
2. Promote use of the area for educational purposes, both by schools and public, including the provision of universal access

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1. Historical Management Practices of the Mai Po Gei Wai. http://awsassets.wwfhk.panda.org/downloads/historical_management_practices_of_the_mai_po_gei_wai.pdf.
2. Mai Po Nature Reserve Habitat Management, Monitoring and Research Plan, 2019-2024, published by WWF. https://www.wwf.org.hk/en/reslib/programme_resources/water_wetlands/

3. Provide facilities for training overseas personnel in wetland management and research techniques
4. Promote scientific research

2.3.8 Please refer to ***Table 2-4*** for an overview of how the Project Elements complement the goals of the habitat management plan.

Table 2-4 Consideration of MPNR Management Objectives Supported by Project Elements

MPNR MANAGEMENT OBJECTIVES	WIDENING OF EXISTING FOOTPATH (NEW BOARDWALK)	CONSTRUCTION OF NEW TOWER HIDE 2	CONSTRUCTION OF NEW TOWER HIDE 3
To maintain or increase populations of priority species by managing the required habitat diversity that integrates climate adaptation strategies.	Replacing the concrete footpath with a raised wooden boardwalk will decrease habitat fragmentation	The location of the hide is designed to ensure that visitors are occluded as much as possible. Additionally, tower hides provide occlusion for a larger area of the reserve	The location of the hide is designed to ensure that visitors are occluded as much as possible. Additionally, tower hides provide occlusion for a larger area of the reserve.
To raise public awareness and education of the importance of wetlands and their conservation, including the provision of universal access.	The wooden boardwalk is conceived with six EAs and seven wheelchair passing bays. The EAs will have interactive and up-to-date information on wetlands	N/A	The west of MPNR, at gei wai 8a, is ideal for public and students, and this tower hide will be purpose built for such activities
To share experience and knowledge with other wetland staging areas in the East Asian-Australasian Flyway (EAAF) for coordinated conservation and persistence of the EAAF avian landscape.	N/A	The south of MPNR is ideal for research, and programmes such as wetland management training and this tower hide will be purpose-built for such activities	N/A
To establish Mai Po as a regional centre of excellence for wetland research.	N/A	The south of MPNR, at gei wai 20e, is a key area for scientific research and this tower hide will be purpose-built for such activities	N/A

2.3.9 During the previous five-year *MPNR Management Plan 2013-2018* recurrent work included controlling vegetation on bunds, islands, channels, and pathways in and along the biodiversity management zones and visitor areas; controlling invasive species; maintaining water quality and levels; and draining gei wai to provide feeding habitats for waterbirds and to remove large, predatory fish. Activities to control feral dogs were carried out, including programmes to trap, neuter and release dogs. Equipment and infrastructure maintenance was also carried out. Major habitat management included desilting gei wai channels (see ***Photograph 2-2 to Photograph 2-7***, below), ponds, and reedbeds; restoring and building islands as planned to provide habitat; and renovating and strengthening bunds.

2.3.10 Each year, specific gei wai within MPNR are drained in accordance with the planned schedule set out in the five-year *MPNR Management Plan* – this activity has been part of the management of MPNR for decades and is not related to the Project. When drained, the gei wai will be as shown in ***Photograph 2-5 to Photograph 2-7*** – large mud pits with dredging and digging of material by machine carried out over several months during the summer.

Photograph 2-2 Desilting Channel (from Pontoon)



Photograph 2-3 Desilting Channel (from Land)



Photograph 2-4 Island Creation Within Drained-down Gei Wai



Photograph 2-5 Bulldozer Working on the Bed of a Drained-down Gei Wai



Photograph 2-6 Transferring Material during Drain-down of Gei Wai



Photograph 2-7 Excavators Working on Drained-down Gei Wai



2.3.11 The programme for construction of the three Project Elements is planned in accordance with AFCD's *Mai Po Inner Deep Bay Ramsar Site Management Plan 2011* and has been timed to tie-in with the *Management Plan 2019-2024*, as shown in ***Table 2-5***, below, which summarises the latest updated timetable for capital and other works at MPNR during the period 2019 to 2024. These include raising the floor of the hut at gei wai 14 by up to 0.5m above the Frontier Closed Area ("FCA") road; electrically-motorized sluice gate trial at gei wai 8; repairing the floor and walls of the floating bird hide; repairing the floor of bird hides #5 and #6; and replacing the roof and exterior wall of the gei wai museum

2.3.12 Specifically, the construction of footings for TH2 and TH3, have been aligned with the planned draining of gei wais 19 and 20e as well as gei wais 7 and 8a, respectively, in spring 2022:

- **Gei wai 19 (TH2)** desilting of channels at 19 and reconnecting 19a and 19b (requiring drain-down).
- **Gei wai 20e (TH2)** is one of the six sub-ponds (20a to 20e) that will be merged into one pond to create deep water open areas for foraging, which includes re-profiling the pond floor (requiring drain-down).
- **Gei wai 7 (TH3)** drain-down to allow installation of a sluice gate to connect 7 and 8a.
- **Gei wai 8a (TH3)** enhancement and connecting 8a and 7 (requiring drain-down).

2.3.13 By scheduling the construction of footings to align with the pre-arranged gei wai drain-down, WWF will ensure that this aspect of construction avoids adverse water quality impacts attributable to the Project – gei wais 7, 8a, 19 and 20e would have been drained anyway, with or without the Project, and the resulting hydraulic isolation prevents any pollution of other gei wais or Deep Bay. The gei wai draining scheduled is overseen by MPNR staff, and seeking approval from the Mai Po Management Committee, whose members include academics from HKU, CUHK, AFCD and HKBWS, together with independent wetlands and waterbird experts.

2.3.14 All infrastructure work scheduled under the *MPNR Management Plan 2019-2024*, including gei wai draining, is carried out from April to October. As such, the Project Proponent has planned to conduct all proposed infrastructure upgrade work during the same period.

Table 2-5 Five-year Work Timetable for Capital and Other Works at MPNR (NOT This Project)

CAPITAL WORK ITEM	YEAR 1 2019	YEAR 2 2020	YEAR 3 2021	YEAR 4 2022	YEAR 5 2023
Creation of 2ha deep water reedbed in GW #8b	H				
Enhancement of reedbed at Pond #23b	H				
Reprofile of Pond #24 f/g	H				
*Desilting of channels and open water restoration at GW #7		H			
Desilting of perimeter channel and control of vegetation encroaching perimeter channel at Pond #16b		M			
Desilting of channels and trial on electrically-motorized sluice gate at GW #8b		H			
Desilting of channels and open water restoration at GW #6			H		
Desilting of channels and trial on removing the internal bunds in GW #12			H M		
***GW #8a enhancement and connecting GW #8a with GW #7**				**H**	
Merging of the 6 sub-ponds (#20a to #20f) and habitat enhancement at Pond #20				**H**	
Desilting of channels at GW #19 and reconnecting GW #19a and #19b				**H**	
Desilting of channels at GW #18 and reconnect GW #18a and #18b					H
Modification of Pond #15a or #15b into aquatic plant demonstration site					L
Open water restoration at GW #3					M
Strategic tree management work:					
Tree survey and planning	H				
Phase I (GW #16, #17, #8, #11)		H			
Phase II (BMZ 1, GW #21, Pond #20)			H		
Phase III (GW #13, #14, #22, #23)				H	
Phase IV (GW #18, GW #19, all paths, Pond #15)					H

Source: Summarised from Chapter 10 and Annex H of the *MPNR Management Plan 2019-2024* (see https://wwfhk.awsassets.panda.org/downloads/mpnr_management_plan_updated_version_june2021.pdf) and its latest updates after the mid-term review in March 2021.

Note: * This table is an excerpt from the *MPNR Management Plan 2019-2024* and its latest updates, and illustrates how the works for the two Tower Hides have been timed to tie-in with the planned maintenance works for MPNR, specifically the drain-down of gei wai. The planned maintenance activities shown in this table do not form part of this Project are also not concurrent projects as shown on the project programme (***Figure 2-6***).

According to the original *MPNR Management Plan 2019-2024*, GW #7 was drained in the wet season of 2020 to carry out "Desilting of channels and open water restoration at GW #7". In 2020, the Mai Po Management Committee advised that that GW #8a and GW #7 should be connected with a sluice gate, when the GW #8a enhancement is carried out. Therefore GW #7 will need to be drained again to facilitate the construction of sluice gate in the summer of 2022. The construction programme for this Project has been revised to align the foundation works to TH3 with the second planned draining of GW#7.

Key: H = High Priority, M = Medium Priority, L = Low Priority.

Bold indicates draw down of gei wais 7, 8a, 19 and 20e in summer 2022 (the foundation works at TH2 and TH3 have been planned to coincide with this).

3 AIR QUALITY IMPACT

3.1 Introduction

3.1.1 This air quality impact assessment has been carried out to identify, qualify and quantify potential air quality impacts arising from the construction of the Project. The criteria and guidelines listed in Annex 4 and Annex 12 of the EIAO-TM are referred to.

3.1.2 The Assessment Area for assessing air quality impact is 500m from the boundary of the Project.

3.2 Legislation, Standards and Guidelines

Air Pollution Control Ordinance

3.2.1 The principal legislation controlling air quality is the *Air Pollution Control Ordinance* (APCO) (Cap. 311). The legislation provides a statutory framework for establishing the Air Quality Objectives and for the control of air pollution from stationary sources and motor vehicles. Air Quality Objectives (AQOs) specifying the statutory limits for seven pollutants and the maximum number of exceedance allowed over a specified period of time are set out under the APCO. The AQOs are periodically reviewed at least once every five years.

3.2.2 The prevailing AQOs and the new AQOs to be enacted from 1 January 2022 for seven pollutants, including Sulphur Dioxide (SO_2), Respirable Suspended Particulates (RSP, PM_{10}), Fine Suspended Particulates (FSP, $PM_{2.5}$), Nitrogen Dioxide (NO_2), Ozone (O_3), Carbon Monoxide (CO) and Lead (Pb), are shown in ***Table 3-1***.

Table 3-1 Hong Kong Air Quality Objectives

POLLUTANT	AVERAGING TIME	PREVAILING AQOs (EFFECTIVE FROM 1 JANUARY 2014)		NEW AQOs (TO BE EFFECTIVE ON 1 JANUARY 2022)	
		CONCENTRATION LIMIT [i] ($\mu g/m^3$)	NUMBER OF EXCEEDANCES ALLOWED	CONCENTRATION LIMIT [i] ($\mu g/m^3$)	NUMBER OF EXCEEDANCES ALLOWED
Sulphur Dioxide (SO_2)	10-minute	500	3	500	3
	24-hour	125	3	50	3
Respirable Suspended Particulates (RSP, PM_{10}) [ii]	24-hour	100	9	100	9
	Annual	50	N/A	50	N/A
Fine Suspended Particulates (FSP, $PM_{2.5}$) [iii]	24-hour	75	9	50	35
	Annual	35	N/A	25	N/A
Nitrogen Dioxide (NO_2)	1-hour	200	18	200	18
	Annual	40	N/A	40	N/A
Ozone (O_3)	8-hour	160	9	160	9
Carbon Monoxide (CO)	1-hour	30,000	0	30,000	0
	8-hour	10,000	0	10,000	0
Lead (Pb)	Annual	0.5	N/A	0.5	N/A

Notes:

i. All measurements of the concentration of gaseous air pollutants, i.e. SO_2, NO_2, O_3 and CO, are to be adjusted to a reference temperature of 293Kelvin and a reference pressure of 101.325 kilopascal.

ii. RSP are suspended particles in air with a nominal aerodynamic diameter of 10µm or less.

iii. FSP are suspended particles in air with a nominal aerodynamic diameter of 2.5µm or less.

Annex 4 of Technical Memorandum under Environmental Impact Assessment Ordinace (EIAO-TM)

3.2.3 For construction dust impact assessment, the EIAO-TM stipulates that the hourly Total Suspended Particulate (TSP) concentration should not exceed 500µg/m^3 measured at 298K (25C) and 101.325 kPa (one atmosphere).

Air Pollution Control (Construction Dust) Regulation

3.2.4 Construction dust is controlled by the *Air Pollution Control (Construction Dust) Regulation* which is enacted under the Section 43 of the APCO. The *Air Pollution Control (Construction Dust) Regulation* defines notifiable works and regulatory works as follows:

- Notifiable Works:
  - Site formation
  - Reclamation
  - Demolition of a building
  - Work carried out in any part of a tunnel that is within 100m of any exit to the open air
  - Construction of the foundation of a building
  - Construction of the superstructure of a building
  - Road construction work
- Regulatory Works:
  - Renovation carried out on the outer surface of the external wall or the upper surface of the roof of a building
  - Road opening or resurfacing work
  - Slope stabilization work
  - Any work involving stockpiling of dusty materials, loading, unloading or transfer of dusty materials, transfer of dusty materials using belt conveyor system, use of vehicles, pneumatic or power-driven drilling, cutting and polishing, debris handling, excavation or earth moving, concrete production, site clearance, or blasting

3.2.5 This Regulation stipulates that for any notifiable works, notice shall be given to EPD before the proposed notifiable work commences to be carried out. For both notifiable and regulatory works, the contractor responsible for the construction site shall ensure that the work is carried out in accordance with the Schedule which provides the control requirement of construction dust.

Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation

3.2.6 This Regulation requires Non-road Mobile Machinery (NRMM), other than those exempted, to comply with the prescribed emission standards. From 1 September 2015, all regulated machines sold or leased for use in Hong Kong must be approved or exempted with a proper label in a prescribed format issued by EPD. Starting from 1 December 2015, only approved or exempted NRMMs with a proper label are allowed to be used in specified activities and locations including construction sites, container terminals and back up facilities, restricted areas of the airport, designated waste disposal facilities and specified processes.

3.3 Description of Environment

3.3.1 There are no areas of industrial use found within the Project Site nor in its vicinity and no chimneys have been identified within 200m of the Project Site.

3.3.2 The closest major road to the Project Site is the New Territories Circular Road/San Tin Highway, which is located about 1.5km from the Project Site. The closest road to the Project Site is Tam Kon Chau Road, a local access road. Within the Project Site is the Boundary Road, which follows the boundary fence.

3.3.3 Tam Kon Chau Road is a local access road, from which significant vehicular emission generated is not anticipated. Vehicles travelling within the Project Site, mainly on the Boundary Road, are

restricted to those used by WWF, the police and AFCD. Considering the limited number of vehicles travelling along Tam Kon Chau Road and within the Project Site, significant impacts from vehicular emissions is not expected.

Background Air Quality

3.3.4 The Project Site is in a rural part of Yuen Long, where the land and its surroundings are mainly gei wai, freshwater ponds, inter-tidal mudflats, mangroves, reedbeds and fishponds. To determine background air quality at the Site, reference can be made to EPD's nearest Air Quality Monitoring Station ("AQMS"), which is at Yuen Long. The latest five-years background air quality concentrations from 2016 to 2020 recorded at Yuen Long AQMS are summarised in ***Table 3-2***.

Table 3-2 Background Air Pollutant Concentrations at Yuen Long AQMS (in µg/m³)

POLLUTANT	AVERAGING TIME	AQO	2016	2017	2018	2019	2020	AVERAGE
RSP	10th highest 24-hour	100	86	87	75	83	77	82
	Annual	50	37	40	37	37	30	36
FSP	10th highest 24-hour	75	63	52	46	45	36	48
	Annual	35	23	22	20	20	16	20
NO_2	19th highest 1-hour	200	149	156	150	161	135	150
	Annual	40	**46**	**41**	**43**	**44**	32	**41**
SO_2	4th highest 10-mins	500	58	80	52	42	26	52
	4th highest 24-hour	125	17	20	16	11	10	15
CO	1-hour	30,000	2,080	1,450	1,720	2,150	1,530	1,786
	8-hour	10,000	1,474	1,324	1,574	1,903	1,279	1,511

Notes:

1. Data extracted from EPD's Yuen Long AQMS.
2. **Bold** values exceed the AQO.

3.3.5 It can be seen that there are a few exceedances of the AQOs recorded at the Yuen Long AQMS, in particular for annual NO_2. This is likely due to influence from exhaust emissions from traffic on the busy Castle Peak Road, which is close to the Yuen Long AQMS. Such exceedances would not be expected at the Project Site given that it is some distance from major roads. The background NO2 at the Project Site is expected to be lower than that recorded at the Yuen Long AQMS due to lower traffic and less exhaust emission from road vehicles at surrounding road network.

3.4 Air Sensitive Receivers

3.4.1 Within the 500m Assessment Area, 13 no. representative Air Sensitive Receivers (ASRs) have been identified in accordance with the guidelines for air quality assessment provided in Annex 12 of the EIAO-TM, as shown in ***Table 3-3***, below. These ASRs include domestic premises at Fairview Park and Palm Springs and a number of village houses in proximity to Tam Kon Chau Road; and offices for AFCD and Yeung's Fish Farm as well as the PSFSC. With the exception of ASR 2 (which is a container converted into a dwelling) and ASR 5, all ASRs are two storey buildings without rooftop access.

3.4.2 Details of the ASRs are shown in Table 3-3 and locations are shown in ***Figure 3-1***.

Table 3-3 Representative ASRs

ASR ID	DESCRIPTION	USE	PATH 2016 GRID	DISTANCE FROM SITE BOUNDARY [Note 1] (m)	DISTANCE FROM NEAREST WORKS AREA [Note 2] m)	ASSESSMENT HEIGHT (mAG) [Note 3]
ASR 1	Village House, Tam Kon Chau Road	Residential	(28, 52)	218	341	1.5, 4.5, 9.5
ASR 2	Occupied Container, Tam Kon Chau Road	Residential	(27, 52)	92	247	1.5, 4.5, 9.5
ASR 3	Village House, Boundary Road	Residential	(27, 52)	< 1	193	1.5, 4.5, 9.5
ASR 4	Village House, Off Tam Kon Chau Road	Residential	(27, 52)	< 1	185	1.5, 4.5, 9.5
ASR 5	Village House/AFCD Nature Warden Office	Residential /Office	(27, 52)	< 1	20	1.5, 4.5, 9.5
ASR 6	House 43, Lychee Road West, Fairview Park	Residential	(27, 51)	118	331	1.5, 4.5, 9.5
ASR 7	House 1, Lychee Road South, Fairview Park	Residential	(27, 51)	149	274	1.5, 4.5, 9.5
ASR 8	House 1, Bauhinia Road West, Fairview Park	Residential	(27, 51)	100	445	1.5, 4.5, 9.5
ASR 9	House 89, Bauhinia Road West, Fairview Park	Residential	(27, 51)	91	846	1.5, 4.5, 9.5
ASR 10	House 183, Bauhinia Road West, Fairview Park	Residential	(27, 50)	400	1,227	1.5, 4.5, 9.5
ASR 11	House 2, Ficus Road, Palm Springs	Residential	(27, 52)	462	586	1.5, 4.5, 9.5
ASR 12	Yeung's Fish Farm	Office	(27, 52)	145	145	1.5, 4.5, 9.5
ASR 13	Peter Scott Field Study Centre, Tam Kon Chau Road	Educational Institute	(27, 52)	116	257	1.5, 4.5, 9.5

Notes:

1. Distance measured between ASRs and nearest boundary of Project Site.
2. Distance measured between ASRs and nearest boundary of nearest works area within Project Site.
3. mAG represents meters above ground.

3.5 Identification of Pollutant Sources – Construction Stage

3.5.1 Fugitive dust is the major impact during construction activities, such as excavation, stockpiling, earth moving, transferring or handling of dusty materials. Dust can also arise from bare ground that is cleared for new boardwalk. The construction works that will be carried out within the Site will be described in the following sections.

3.5.2 ***Figure 3-2*** shows the locations of the pollutant sources within the Site.

Construction Works within the Project Site

Tower Hides

3.5.3 TH2 has a footprint of 60m^2. The maximum works area will be in Phase 1 and will occupy 835m^2, which is assumed to be cleared bare ground – see ***Figure 2-4***. TH3 also has a footprint of 60m^2. The maximum works area will be in Phase 1 and will occupy 940m^2, which is also assumed to be cleared bare ground – see ***Figure 2-5***.

3.5.4 Construction of TH2 and TH3 will involve excavation for footings/substructure, followed by construction of superstructure works. Given that the new tower hides are simple 3-storey buildings with a relatively small works area, air quality impacts due to construction are not expected to be significant.

Boardwalks

3.5.5 As discussed in ***Section 2.3***, the maximum area bare ground for boardwalk construction at any one time is 465m^2. Nonetheless, given that the equipment used for new boardwalk will be hand-held power tools and manual labour, dust emissions and emissions from PME are expected to be minor.

Vehicle Movement Within the Site

3.5.6 Fugitive dust emissions will be generated from the movement of vehicles along existing paved roads (the Boundary Road), the unpaved temporary access routes within the Project Site, and external paved roads. Vehicles will include dump trucks, concrete trucks, and light trucks, etc., within the range of 5.5 tonnes to 38 tonnes. ***Figure 3-2*** shows the worst-case vehicle movements on each of these haul routes, as agreed with the Project Proponent and the Project Engineer. As the scale of construction works is small, the total numbers of vehicle movement within the Site at one time will be not more than 5 vehicles/hour, which is considered limited.

Construction Works of Concurrent Projects

3.5.7 The demolition and rebuild of PSFSC near MPNR will have been completed by March 2022 whereas the construction of this Project will commence at end-April 2022. As such, the demolition and rebuild of PSFSC will not be carried out concurrently with this Project. There are also no other concurrent projects near MPNR. Thus, cumulative air quality impacts for this Project is not anticipated.

3.5.8 As shown in the Project Programme in ***Figure 2-6***, there are also no concurrent works related to the *MPNR Management Plan 2019-2024* and so no cumulative air quality impacts.

3.6 Assessment Methodology – Construction Stage

3.6.1 For typical construction projects, fugitive dust – measured as Total Suspended Particulates (TSP), RSP and FSP – is the major impact during construction activities, such as excavation, stockpiling, earth moving, transferring or handling of dusty materials. Dust can also arise from bare ground. However, for this Project, the construction activities that could generate dust are small in scale and short in duration, as the outdoor works for the Project within the MPNR will be completed within three months. Furthermore, the area of bare ground (for new boardwalk) is also relatively small.

3.6.2 One of the key design features of this Project is the use of off-site pre-fabrication. Building elements – wall panels, roof segments, windows, etc. – will be fabricated off-site and brought to MPNR for assembly. This way, typical dust impacts associated with on-site construction will be avoided as most construction work is simple assembly. Some excavation is required for foundations of the tower hides, but the excavated material will be wet and will not generate dust.

3.6.3 Baseline air quality monitoring was carried out (in March and April 2020) at ASR 1 and ASR 2 and the measured TSP concentrations are summarised in ***Table 3-4***, below.

Table 3-4 Ambient Air Quality at ASR 1 and ASR 2

DATE	TIME	1-HOUR TSP (µg/m³) ASR 1 VILLAGE HOUSE, TAM KON CHAU ROAD	ASR 2 OCCUPIED CONTAINER, TAM KON CHAU ROAD
30 March 2020	10:00 – 11:00	78	41
	11:00 – 12:00	19	13
	12:00 – 13:00	15	16
31 March 2020	10:00 – 11:00	90	82
	11:00 – 12:00	23	22
	12:00 – 13:00	102	99
1 April 2020	10:00 – 11:00	50	45
	11:00 – 12:00	51	46
	12:00 – 13:00	63	54
2 April 2020	08:45 – 09:45	69	67
	09:45 – 10:45	63	59
	11:45 – 12:45	68	63
3 April 2020	10:00 – 11:00	107	106
	11:00 – 12:00	123	118
	12:00 – 13:00	116	143
	Average (µg/m³)	**69**	**65**

3.6.4 The baseline air quality monitoring results represent ambient air quality in the vicinity of MPNR and it can be seen that averaged 1-hour TSP is less than 70µg/m³, which is more than 7x lower than 500µg/m³ limit mentioned under Annex 4 of TM-EIAO. These findings indicate that the vicinity of the Project Site has a very low ambient TSP concentrations.

3.6.5 Given the small scale of construction works and its short duration, limited vehicle movement and well planned routing of vehicles within the Site, together with the use of off-site pre-fabrication as far as practicable, adverse construction dust impacts generated from construction activities and vehicle movement around the Site is not anticipated. Also, the nearest ASR is about 20m from the works area, adverse construction dust impact is not expected. With the implementation of good site practices and mitigation measures as recommended in ***Section 3.7***, the overall generation of construction dust during construction phase will be minimal.

3.6.6 Since the construction works will be of small scale there will be limited use of plant such as NRMM during construction. Also, it is a statutory requirement under the *Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation* that only those regulated machines which have been approved or exempted with a proper label in a prescribed format issued by EPD will be allowed to be used on-site during construction phase. The contractors shall strictly fulfil the relevant requirement, and therefore emissions from NRMMs shall be controlled and adverse air quality impacts on ASRs arising from vehicle emissions is not anticipated.

3.6.7 As shown in ***Table 3-2***, the actual ambient concentrations of RSP and FSP at Yuen Long AQMS in 2020 are well within the AQO limits. Given that most of the dust impacts typically associated with on-site construction have been avoided due to the off-site pre-fabrication of building elements and that the area of bare ground (for new boardwalk) is also relatively small, it is not considered that dust arising from the construction stage will result in any exceedance of the AQOs.

3.6.8 On this basis, no unacceptable air quality impacts are anticipated. Nevertheless, mitigation measures will be implemented at all times to further reduce dust impacts to minimum possible, as discussed below.

3.7 Mitigation Measures

Mitigation Measures During Construction Stage

3.7.1 Fugitive dust generation can be controlled with the implementation of mitigation measures that are recommended in the *Air Pollution Control (Construction Dust) Regulation*, such that significant fugitive dust impact is not anticipated.

3.7.2 Good practice and mitigation measures to be implemented are as follows:

- Regular watering to reduce dust emissions from exposed site surfaces and unpaved roads, particularly during dry weather.
- Open stockpiles shall be avoided or covered. Where possible, prevent placing dusty materials storage piles near ASRs.
- Side enclosure of any aggregate or dusty material storage piles to reduce emissions. Where this is not practicable owing to frequent usage, spraying with water shall be carried out.
- Tarpaulin covering of all dusty vehicle loads transported to and from the Site.
- Use of water sprinklers at the loading area where dust generation is likely during the loading process of loose material, particularly in dry weather.
- Imposition of speed controls for vehicles within the Site.
- Establishment and use of vehicle wheel and body washing facilities at the exit of the Site to minimise the fugitive dust emissions generated.
- Site layout should be carefully planned such that machinery and dust causing activities (e.g. haul roads and stockpiling areas) could be located away from the ASR as far as possible.
- Where possible, routing of vehicles and positioning of construction plant should be at the maximum possible distance from ASRs.
- Solid screens are recommended to be erected around any dusty construction activities.

3.8 Conclusion

3.8.1 Baseline air quality monitoring results at ASR 1 and ASR 2 reveal that ambient air quality in terms of averaged 1-hour TSP is less than 70µg/m^3, which is more than 7x lower than 500µg/m^3 limit mentioned under Annex 4 of TM-EIAO. Given the small scale of construction work and the small area of bare ground that could be a source of fugitive construction dust emissions, it is not expected that there will be any exceedance of the 500µg/m^3 limit at ASRs, the majority of which are located at some distance from works areas.

3.8.2 The actual ambient concentrations of RSP and FSP at Yuen Long AQMS in 2020 are well within the AQO limits. Given that most of the dust impacts typically associated with on-site construction have been avoided due to the off-site pre-fabrication of building elements and that the area of bare ground (for new boardwalk) is also relatively small, no significant increase in air quality impact at ASRs is anticipated during construction and no exceedance of AQO limits for RSP and FSP is expected.

3.8.3 Given the small scale of construction works and its short duration, limited vehicle movement and well planned routing of vehicles within the Site, together with the use of off-site pre-fabrication as far as practicable, adverse construction dust impacts generated from construction activities and vehicle movement around the Site is not anticipated.

3.8.4 Since the construction works will be of small scale there will be limited use of plant such as NRMM during construction. As contractors shall follow the *Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation*, emissions from NRMMs shall be controlled and so adverse air quality impact at ASRs arising from mobile machinery emissions is not anticipated.

3.8.5 Overall, therefore, with the implementation of mitigation measures and good site practice, no adverse air quality impact is anticipated during the construction stage.

4 NOISE IMPACT

4.1 Introduction

4.1.1 This noise impact assessment has been carried out to identify, qualify and quantify potential noise impacts arising from the construction of the Project. The criteria and guidelines listed in Annex 5 and Annex 13 of the EIAO-TM are referred to.

4.1.2 The Assessment Area for assessing noise impact is 300m from the boundary of the Project.

4.2 Legislation, Standards and Guidelines

Construction Noise

4.2.1 The principle legislation controlling environmental noise impact is the *Noise Control Ordinance* (NCO) (Cap. 400). The NCO enables regulations and Technical Memoranda (TM) to be enacted, which introduce detailed control criterion, measurement procedures and other technical matters.

General Construction Activities During Non-restricted Hours

4.2.2 For general construction works other than percussive piling, although TM does not provide control over daytime (0700 to 1900 hours on any day not being a Sunday or general holiday) construction activities, noise limits are set out in Table 1B of Annex 5 of the EIAO-TM for Designated Projects. The relevant noise standards are summarised in ***Table 4-1***.

Table 4-1 Noise Standards for Daytime Construction Activities

USES	0700 TO 1900 HOURS ON ANY DAY NOT BEING A SUNDAY OR GENERAL HOLIDAY $L_{EQ(30\ MINS)}$ dB(A)	1900 TO 0700 HOURS OR ANY TIME ON SUNDAYS OR GENERAL HOLIDAY
All domestic premises including temporary housing accommodation	75	The criteria laid down in the relevant technical memoranda under the NCO for designated areas and construction works other than percussive piling may be used for planning purposes. A Construction Noise Permit (CNP) shall be required for carrying out of the construction work during these periods
Hotel and hostels	75	
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	70 65 (during examinations)	

Notes:

i. The above standards apply to uses which rely on opened windows for ventilation.
ii. The above standards should be viewed as the maximum permissible noise levels assessed at 1 m from the external façade.

General Construction Activities During Restricted Hours

4.2.3 Noise impacts arising from general construction activities (excluding percussive piling) conducted during the restricted hours (19:00-07:00 hours on any day and anytime on Sunday or general holiday) are governed by the NCO.

4.2.4 For carrying out of any general construction activities involving the use of any Powered Mechanical Equipment ("PME") within restricted hours, a Construction Noise Permit (CNP) is required from the Authority under the NCO. The noise criteria and the assessment procedures for issuing a CNP are specified in *Technical Memorandum on Noise from Construction Work Other Than Percussive Piling* (GW-TM) under the NCO.

4.2.5 The use of Specified PME ("SPME") and/or the carrying out of Prescribed Construction Work ("PCW") within a Designated Area ("DA") under the NCO during the restricted hours are also prohibited without a CNP. The relevant technical details can be referred to *Technical*

Memorandum on Noise from Construction Work in Designated Areas (DA-TM) under NCO. Designated Areas, in which the control of SPME and PCW shall apply, are established through the *Noise Control (Construction Work Designated Areas) Notice* made under Section 8A(1) of the NCO. According to the latest Designated Areas defined under the NCO [Plan No. EPD/AN/NT-01 by the Environment Bureau], the Project Site is not within Designated Areas, however, prior to construction, the Contractor has the responsibility to check the latest status and coverage of the Designated Areas.

Percussive Piling

4.2.6 Percussive piling is only permitted when the Authority has granted a CNP. The *Technical Memorandum on Noise from Percussive Piling* (PP-TM) under the NCO sets out the permitted hours of operation of percussive piling and Acceptable Noise Level ("ANL") requirements, which are dependent on the level of exceedance of the Acceptable Noise Level ("ANL"). For this Project, percussive pilling will not be carried out.

4.3 Prevailing Noise Environment

Prevailing Noise Environment

4.3.1 The Project Site is the MPNR, known for its wildlife and tranquillity. There are no major roads nearby and very little vehicular traffic. Inside MPNR there are no major noise sources and the prevailing noise environment is rural and low noise.

4.3.2 Outside the Site, the closest development to the Site is the Fairview Park residential estate, which itself is a low-density development of predominantly two-storey terraced houses. The prevailing noise environment of Fairview Park is also rural and low noise. Near to the entrance of the Site are some scattered village houses, the closest being those two-storey dwellings on Boundary Road and near AFCD Nature Warden Office. Again, the prevailing noise environment is rural and low noise.

4.3.3 In terms of the noise environment with and without the Project, there will be almost no difference. The new structures to be constructed – TH2, TH3 and the footpaths – are not themselves noise sources. The only possible increase in noise will be from the increased number of visitors that are anticipated after completion of the Project. However, given that visitors to MPNR are usually quiet so as not to disturb wildlife, and that group visits are guided by WWF Education Officers/Eco-guides, in terms of the noise environment it is not considered to be any dis-benefit with the Project, compared to without the Project.

Background Noise Survey

4.3.4 A prevailing background noise survey was conducted on 27 August 2019 during the day time period at a number of locations in proximity of and within the Project boundary. The measured background noise levels are summarised in ***Table 4-2***, below, and the locations of the measurement are shown in ***Figures 4-1 and 4-2***. Details of the measurement are presented in ***Appendix A1***.

Table 4-2 Measured Background Noise Levels

LOCATION	DESCRIPTION	NOISE LEVEL $L_{EQ(30MIN)}$ dB(A)
ON-SITE MONITORING LOCATIONS		
M1	Existing Footpath	49
M2	Existing Tower Hide TH3	69*
M3	Existing Footpath	58
M4	Mai Po Education Centre	58
M5	Temporary Access Road in the Middle of the Site	50
M6	South of the Site	47

LOCATION	DESCRIPTION	NOISE LEVEL $L_{EQ(30MIN)}$ dB(A)
M7	Location of Proposed Tower Hide TH2	42
M8	North of the Site Boundary	49
M9	North of the Site	51
M10	Northwest of the Site Boundary	50
M11	North of the Site	41
M12	West of the Site Boundary	49
M13	Southwest of the Site Boundary	45
M14	South of the Site Boundary	49
OFF-SITE MONITORING LOCATIONS		
M15	Entrance of the Site/Village Houses Near Ranger Station	46
M16	Mai Po Visitor Centre at PSFSC	47
M20	Near Fairview Park Bauhinia Road West House 1	56
M21	Near Fairview Park Lychee Road South House 1	56
M22	Tam Kon Chau Road Village House	51

Notes: Measurements were conducted in free-field condition.

* A diesel generator was operating around 10m from M2, which is the reason for the relatively high reading.

4.4 Assessment Area

4.4.1 The Assessment Area is the area within 300m of the Project boundary, as shown in ***Figure 4-3***. Although the Assessment Area extends 300m from the Project boundary, only the first-tier, closest, Noise Sensitive Receivers (NSRs) are chosen as representative NSRs, as these would be affected to a greater extent than those further away. Further than 300m from the Project boundary there are no significant NSRs that need to be included in the assessment.

4.5 Noise Sensitive Receivers

4.5.1 All existing NSRs are shown in ***Figure 4-3*** and comprise all residential units within 300m of the Project boundary. However, only the first-tier, closest, NSRs have been identified as representative NSRs for the purpose of assessment. These are summarised in ***Table 4-3*** and their locations are shown in ***Figure 4-3***. Photographs of the representative NSRs showing the Assessment Points are provided in ***Appendix A2***. MPEC, which is located within the Project Site, does not rely on openable windows for ventilation and so the noise standards stipulated in Annex 5 of the EIAO-TM are not applicable, which is why MPEC is not selected as a representative NSR.

Table 4-3 Representative NSRs

NSR ID	DESCRIPTION	USE	DISTANCE FROM SITE[Note 1] (m)	NO. FLOORS	ASSESSMENT POINT[Note 2]
NSR 1	Village House, Tam Kon Chau Road	Residential	218	G/F, 1/F	G/F (5.6mPD)
NSR 2	Occupied Container, Tam Kon Chau Road	Residential	92	G/F	G/F (5.6mPD)
NSR 3	Village House, Boundary Road	Residential	< 1	G/F, 1/F	G/F (5.6mPD)
NSR 4	Village House, Off Tam Kon Chau Road	Residential	< 1	G/F, 1/F	G/F (5.6mPD)
NSR 5	Village House, near AFCD Nature Warden Office	Residential	< 1	G/F, 1/F	G/F (5.6mPD)

NSR ID	DESCRIPTION	USE	DISTANCE FROM SITE[Note 1] (m)	NO. FLOORS	ASSESSMENT POINT[Note 2]
NSR 6	House 43, Lychee Road West, Fairview Park	Residential	118	G/F, 1/F	G/F (5.9mPD)
NSR 7	House 1, Lychee Road South, Fairview Park	Residential	149	G/F, 1/F	G/F (5.6mPD)
NSR 8	House 1, Bauhinia Road West, Fairview Park	Residential	100	G/F, 1/F	G/F (5.4mPD)
NSR 9	House 89, Bauhinia Road West, Fairview Park	Residential	91	G/F, 1/F	G/F (5.2mPD)
NSR 10	Peter Scott Field Study Centre, Tam Kon Chau Road	Educational Institute	116	G/F, 1/F	G/F (5.6mPD)

Notes:

1. Distances are measured between NSRs and the nearest boundary of Project Site.
2. mPD represents meters per datum. This value is 1.2m above ground level at each NSR.

4.6 Identification of Noise Sources – Construction Stage

Construction Works within the Project Site

4.6.1 Noise impacts arising from construction of the Project are mainly due to the use of PME for various construction activities. The major construction works of the Project are:

- Construction of New TH2 (including Boardwalk Access)
- Construction of TH3 (including Boardwalk Access)
- Construction of Main Boardwalks
  - above existing paths (including passing bays)
  - for EAs

4.6.2 In addition to the construction of the above Project Elements, there will also be movement of construction vehicles within and adjacent to the Project Site, running along the existing Boundary Road (paved), temporary access routes along the top of bunds (unpaved) within the Project Site, and external paved roads. Vehicles will include dump trucks, concrete trucks and light pick-up trucks, etc., within the range of 5.5 tonnes to 38 tonnes. The locations of the above construction works and haul roads were shown in ***Figure 4-4***.

4.6.3 The construction programme has been arranged such that construction work during Restricted Hours will not be required. Also, percussive piling will not be required. To avoid disturbance on habitats and birds, there shall be no noisy outdoor construction work other than mobilisation and vehicle movement from 16 October to 15 April. This recommended constraint on construction period are recommendations from ecological point of view and has been adopted in the construction programme given in ***Figure 2-6***.

4.6.4 The types and quantities of PME to be used are limited. An inventory of the PME used in the construction work of the Project is given in ***Appendix A3***, which has been confirmed by the Project Engineer.

Construction Works of Concurrent Projects

4.6.5 The demolition and rebuild of PSFSC near MPNR will have been completed by March 2022 whereas the construction of this Project will commence at end-April 2022. As such, the demolition and rebuild of PSFSC will not be carried out concurrently with this Project. There are also no other concurrent projects near MPNR. Thus, cumulative noise impacts for this Project is not anticipated.

4.6.6 As shown in the Project Programme in ***Figure 2-6***, there are also no concurrent works related to the *MPNR Management Plan 2019-2024* and so no cumulative noise impacts.

4.7 Assessment Methodology – Construction Stage

4.7.1 As discussed above, the noise impact assessment is focused to the potential noise impact arising from the construction stage of the Project.

4.7.2 The assessment of construction noise impact was carried out quantitatively based on the guidelines given in GW-TM issued under the NCO where appropriate. Sound Power Levels (SWLs) of PME make reference to Table 3 of the TM and the *Sound Power Levels of Other Commonly Used PME* available in EPD's website[Ref.#3]. Notional source position has been adopted for each work area with respect to each NSR. For construction of new tower hides involving two working phases, Phase 1 with a larger site area has been used to determine the notional source position as this will give the shortest distance to NSRs, which is the more conservative approach. The works areas of Phase 1 construction of the 2 tower hides, the notional source positions and NSRs are shown in ***Appendix A4***.

4.7.3 The noise assessment includes erection of site hoarding/fencing around the works areas for the two new tower hides – this is subject to BD requirements but has been included to provide a conservative estimate of construction noise. In the event that erection of site hoarding is not required, the predicted noise levels are expected to be lower than predicted as works for site hoarding is eliminated.

4.7.4 For the assessment of noise from the mobile plant and vehicles travelling along existing paved roads and temporary access roads within the Project Site, the *Method for Mobile Plant Using a Regular Well-Defined Route* stipulated in BS5228-1 Annex F was adopted.

4.7.5 A positive 3dB(A) correction was applied to the predicted noise level to account for the façade effect at each assessment point.

4.8 Assessment Results – Construction Stage

4.8.1 The noise impact arising from construction of the Project at the representative NSRs has been predicted and the results are summarised in ***Table 4-4***. Details of the assessment are presented in ***Appendix A4***.

Table 4-4 Predicted Noise Impact at Representative NSRs

NSR ID	NOISE CRITERIA, dB(A)	PREDICTED CONSTRUCTION NOISE LEVEL $L_{EQ(30\ MIN)}$ dB(A) UNMITIGATED SCENARIO
NSR 1	75	50 – 58
NSR 2	75	54 – 60
NSR 3	75	56 – 61
NSR 4	75	56 – 61
NSR 5	75	66 – 68
NSR 6	75	49 – 57
NSR 7	75	50 – 57
NSR 8	75	48 – 56
NSR 9	75	45 – 54
NSR 10	70	53 – 59

Note: **Bold** indicates exceedance of noise criteria (no exceedance due to Project).

4.8.2 Results show that the construction noise impacts at all NSRs comply with relevant noise criteria.

3. http://www.epd.gov.hk/epd/sites/default/files/epd/english/application_for_licences/guidance/files/OtherSWLe.pdf

4.9 Mitigation Measures

Mitigation Measures During Construction Stage

4.9.1 The Contractor should adopt good working practices in order to further minimise noise, such as:

- No noisy outdoor construction work other than mobilisation and vehicle movement from 16 October to 15 April 2021 to avoid disturbance on habitats and birds as recommendations from ecological point of view.
- The Contractor shall adopt the *Code of Practice on Good Management Practice to Prevent Violation of the NCO (for Construction Industry)* published by EPD.
- Before commencing any work, the Contractor shall submit to the Project Engineer for approval the method of working, equipment and noise mitigation measures intended to be used at the Site.
- Devise and execute working methods to minimise the noise impact on the surrounding sensitive uses, and provide experienced personnel with suitable training to ensure that those methods are implemented.
- PME should be kept to a minimum and the parallel use of noisy equipment/ machinery should be avoided.
- Turn off unused equipment.
- Regular maintenance (off-site) of all plant and equipment.

4.10 Conclusion

4.10.1 The noise impact arising from the construction of the Project at representative NSRs has been assessed and shows that noise levels at these NSRs will comply with relevant noise criteria. As such, further noise mitigation measures during construction are not necessary.

4.10.2 Overall, therefore, no adverse noise impact is anticipated from the construction of the Project.

5 WATER QUALITY IMPACT

5.1 Introduction

5.1.1 This water quality impact assessment has been carried out to identify, qualify and quantify potential water quality impacts arising from the construction and operation of the Project. The criteria and guidelines listed in Annex 6 and Annex 14 of the EIAO-TM are referred to.

5.1.2 The Assessment Area for assessing water quality impact is 500m from the boundary of the Project, which includes water courses and ponds in the vicinity of the Project, and also the Deep Bay Water Control Zone (WCZ).

5.2 Legislation, Standards and Guidelines

Water Pollution Control Ordinance

5.2.1 The principle legislation controlling water pollution is the *Water Pollution Control Ordinance* (WPCO) (Cap. 358). Under the WPCO, Hong Kong waters are classified into 10 Water Control Zones (WCZ). The Project Site is situated within the catchment area of the Deep Bay WCZ.

5.2.2 Statutory Water Quality Objectives (WQOs) are specified for each WCZ. The WQOs for any particular waters, as defined in the WPCO, shall be the quality, which should be achieved and maintained in order to promote conservation and best use of those waters in the public interest. The WQOs designated for Deep Bay WCZ are listed in ***Table 5-1***.

Table 5-1 Water Quality Objectives for Deep Bay WCZ

WATER QUALITY OBJECTIVE		PART OR PARTS OF ZONE
A. AESTHETIC APPEARANCE		
(a)	Waste discharges shall cause no objectionable odours or discolouration of the water.	Whole Zone
(b)	Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole Zone
(c)	Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole Zone
(d)	There should be no recognisable sewage-derived debris.	Whole Zone
(e)	Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole Zone
(f)	Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole Zone
B. BACTERIA		
(a)	The level of *Escherichia coli* should not exceed 610 per 100 mL, calculated as the geometric mean of all samples collected in one calendar year.	Secondary Contact Recreation Subzone and Mariculture Subzone
(b)	The level of *Escherichia coli* should be zero per 100 ml, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones

WATER QUALITY OBJECTIVE		PART OR PARTS OF ZONE
(c)	The level of *Escherichia coli* should not exceed 1000 per 100 ml, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
(d)	The level of *Escherichia coli* should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive in one calendar year. Samples should be taken at least 3 times in a calendar month at intervals of between 3 and 14 days.	Yung Long Bathing Beach Subzone
C. COLOUR		
(a)	Waste discharges shall not cause the colour of water to exceed 30 Hazen units.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
(b)	Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
D. DISSOLVED OXYGEN		
(a)	Waste discharges shall not cause the level of dissolved oxygen to fall below 4 milligrams per litre for 90% of the sampling occasions during the year; values should be taken at 1 metre below surface.	Inner Marine Subzone excepting Mariculture Subzone
(b)	Waste discharges shall not cause the level of dissolved oxygen to fall below 4 milligrams per litre for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 2 measurements at 1 metre below surface and 1 metre above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 milligrams per litre within 2 metres of the seabed for 90% of the sampling occasions during the year.	Outer Marine Subzone excepting Mariculture Subzone
(c)	The dissolved oxygen level should not be less than 5 milligrams per litre for 90% of the sampling occasions during the year; values should be taken at 1 metre below surface.	Mariculture Subzone
(d)	Waste discharges shall not cause the level of dissolved oxygen to be less than 4 milligrams per litre.	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone, Water Gathering Ground Subzones and other inland waters in the Zone
E. pH		
(a)	The pH of the water should be within the range of 6.5-8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 units.	Marine waters excepting Yung Long Bathing Beach Subzone
(b)	Waste discharges shall not cause the pH of the water to exceed the range of 6.5-8.5 units.	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
(c)	The pH of the water should be within the range of 6.0-9.0 units.	Other inland waters

WATER QUALITY OBJECTIVE		PART OR PARTS OF ZONE
(d)	The pH of the water should be within the range of 6.0-9.0 units for 95% of samples. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 units.	Yung Long Bathing Beach Subzone
F. TEMPERATURE		
	Waste discharges shall not cause the natural daily temperature range to change by more than 2.0 degrees Celsius.	Whole Zone
G. SALINITY		
	Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole Zone
H. SUSPENDED SOLIDS		
(a)	Waste discharges shall neither cause the natural ambient level to be raised by 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine waters
(b)	Waste discharges shall not cause the annual median of suspended solids to exceed 20 milligrams per litre.	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Ganges Subzone, Indus Subzone, Water Gathering Ground Subzones and other inland waters
I. AMMONIA		
	Un-ionized ammoniacal nitrogen level should not be more than 0.021 milligram per litre, calculated as the annual average (arithmetic mean).	Whole Zone
J. NUTRIENTS		
(a)	Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Inner and Outer Marine Subzones
(b)	Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.7 milligram per litre, expressed as annual mean.	Inner Marine Subzone
(c)	Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 milligram per litre, expressed as annual water column average (arithmetic mean of at least 2 measurements at 1 metre below surface and 1 metre above seabed).	Outer Marine Subzone
K. 5-DAY BIOCHEMICAL OXYGEN DEMAND		
(a)	Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 3 milligrams per litre.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
(b)	Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 5 milligrams per litre.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters

WATER QUALITY OBJECTIVE		PART OR PARTS OF ZONE
L. CHEMICAL OXYGEN DEMAND		
(a)	Waste discharges shall not cause the chemical oxygen demand to exceed 15 milligrams per litre.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
(b)	Waste discharges shall not cause the chemical oxygen demand to exceed 30 milligrams per litre.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
M. TOXINS		
(a)	Waste discharges shall not cause the toxins in water to attain such levels as to produce significant toxic carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	Whole Zone
(b)	Waste discharges shall not cause a risk to any beneficial uses of the aquatic environment.	Whole Zone
N. PHENOL		
	Phenols shall not be present in such quantities as to produce a specific odour, or in concentration greater than 0.05 milligrams per litre as C_6H_5OH.	Yung Long Bathing Beach Subzone
O. TURBIDITY		
	Waste discharges shall not reduce light transmission substantially from the normal level.	Yung Long Bathing Beach Subzone

Note: Refers to Key WQOs for river monitoring stations in the Northwestern New Territories, *River Water Quality in Hong Kong in 2018* published by EPD and Statement of WQOs (Deep Bay Control Zone), Schedule of Cap 358R.

5.2.3 An amendment to the WPCO was enacted in 1990 and provides a mechanism for setting effluent standards. These are included in the *Technical Memorandum Standards for Effluents Discharged in to Drainage and Sewerage Systems, Inland and Coastal Waters*. All discharges into government sewerage systems, marine and inland waters are required to comply with the standards stipulated in the *Technical Memorandum*.

5.2.4 Any discharge from the Project Site shall comply with the standards for effluent discharge into inland waters. Standards for effluents discharged into Group C inland waters are adopted, which are also provided in ***Table 5-2*** for reference.

Table 5-2 Standards for Effluent Discharged into Group C Inland Waters

DETERMINAND	FLOW RATE (m^3/DAY)			
	≤100	>100 AND ≤500	>500 AND ≤1000	>1000 AND ≤2000
pH (pH units)	6-9	6-9	6-9	6-9
Temperature (°C)	30	30	30	30
Colour (lovibond units)	1	1	1	1
Suspended solids	20	10	10	5
BOD	20	15	10	5
COD	80	60	40	20
Oil & Grease	1	1	1	1
Boron	10	5	4	2
Barium	1	1	1	0.5
Iron	0.5	0.4	0.3	0.2

DETERMINAND	FLOW RATE (m^3/DAY)			
	≤100	>100 AND ≤500	>500 AND ≤1000	>1000 AND ≤2000
Mercury	0.001	0.001	0.001	0.001
Cadmium	0.001	0.001	0.001	0.001
Silver	0.1	0.1	0.1	0.1
Copper	0.1	0.1	0.05	0.05
Selenium	0.1	0.1	0.05	0.05
Lead	0.2	0.2	0.2	0.1
Nickel	0.2	0.2	0.2	0.1
Other toxic metals individually	0.5	0.4	0.3	0.2
Total toxic metals	0.5	0.4	0.3	0.2
Cyanide	0.05	0.05	0.05	0.01
Phenols	0.1	0.1	0.1	0.1
Sulphide	0.2	0.2	0.2	0.1
Fluoride	10	7	5	4
Sulphate	800	600	400	200
Chloride	1,000	1,000	1,000	1,000
Total phosphorus	10	10	8	8
Ammonia nitrogen	2	2	2	1
Nitrate + nitrite nitrogen	30	30	20	20
Surfactants (total)	2	2	2	1
E. coli (count/100ml)	1,000	1,000	1,000	1,000

Note: All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated.

Construction Site Drainage, ProPECC PN1/94

5.2.5 Under ProPECC Practice Note PN1/94 Construction Site Drainage (ProPECC PN1/94), various guidelines for the handling and disposal of construction site discharges are included. The guidelines include the use of sediment traps, wheel washing facilities for vehicles leaving the Site, adequate maintenance of drainage systems to prevent flooding and overflow, sewage collection and treatment, and comprehensive waste management (collection, handling, transportation, and disposal) procedures.

Town Planning Board Guidelines for Application for Developments within Deep Bay Area under Section 16 of the Town Planning Ordinance (TPB PG-No. 12C)

5.2.6 TPB PG-No. 12C (Revised May 2014) are the Town Planning Board (TPB) Guidelines for Application for Developments within Deep Bay Area under Section 16 of the Town Planning Ordinance. The Project is located within the Deep Bay Area and is subject to a Section 16 Planning Application.

5.2.7 *TPB PG-No. 12C* simply requires that new developments "…should not add to the pollution loading of the Deep Bay Area". Essentially this means that no additional pollution loading shall be allowed above existing levels.

5.2.8 WWF understand the reasoning behind the need to protect the Deep Bay Area and so will also follow this requirement as it pertains to the Project, primarily in achieving "Zero Pollutants", as described in "Zero Water Pollution – the WWF Approach" in ***paragraphs 5.4.12 to 5.4.34***, below.

Deep Bay Guidelines for Drainage, Reclamation and Drainage Works

5.2.9 These Guidelines were prepared back in 1991 to ensure that any necessary dredging, reclamation and drainage works carried out in the Deep Bay Area are executed in such a way that the particular environmental value and sensitivity of the area are fully recognised, respected and adequately taken into account.

5.2.10 Although these Guidelines are out of date and the works do not involve dredging, reclamation or drainage works out in the Deep Bay Area, these Guidelines have nevertheless been reviewed to ensure that the works have been designed to achieve the intent of the Guidelines.

5.3 Historic and Current Setting

Deep Bay

5.3.1 Deep Bay is an ecologically important one, with extensive intertidal mudflats backed by mangal, tidal gei wai and fishponds. Oyster culture is a feature of Deep Bay and it has the largest and most important mangrove habitat in Hong Kong. The mudflats of Inner Deep Bay also have high conservation value as an important feeding ground for a huge number of resident and migratory birds. The Mai Po and Inner Deep Bay Ramsar Site was recognised in 1995 as a “Wetland of International Importance”.

5.3.2 The Bay is large, shallow, and sediment-laden, with an average depth of about 2.9m and a mean tidal range of 1.4m. Because of its shallowness, the presence of these muddy habitats as well as the strong riverine inputs from within and outside, the Bay naturally has high Suspended Solids (SS) levels.

5.3.3 Pollution flows into the bay from the catchments and rivers on both the Hong Kong and Shenzhen sides. This has resulted in poor water quality especially in Inner Deep Bay, which typically records high levels of SS, turbidity, organic matter (BOD_5 and Chemical Oxygen Demand), nutrients (nitrogen and phosphate) and *E. coli* bacteria, but better water quality in Outer Deep Bay, indicating that pollutants are being gradually diluted as they move out to sea.

5.3.4 Specifically, according to the most recent water quality monitoring data from EPD[Ref#5], the overall compliance rate of the Deep Bay WCZ with its WQOs (shown in ***Table 5-1***) was 67% in 2019 as compared to a ten-year average of 47% in 2009 - 2018.

5.3.5 The Dissolved Oxygen (DO) and Unionised Ammonia Nitrogen (NH_3-N) WQOs were fully complied with. Although Deep Bay, as compared with other WCZs, had higher nutrient levels with annual depth-averaged Total Inorganic Nitrogen (TIN) levels exceeding the respective TIN WQOs, a noticeable long-term decrease in TIN levels since mid-2000s has been seen.

5.3.6 Also, there were only few reported cases of red tides in Deep Bay, likely ascribed to the presence of considerable areas of unique wetland habitats and the high background turbidity which could become a key factor limiting the photosynthesis and growth of phytoplankton in the bay despite ample local nutrients supply.

5.3.7 The extent of the Deep Bay WCZ and the location of EPD’s water quality monitoring Stations DM1 – DM5 are shown in ***Figure 5-1***. A summary of water quality monitoring results for stations in Deep Bay for the past five years are given in ***Table 5-3***, below.

5. *Marine Water Quality in Hong Kong in 2019*, published by EPD in 2020.

Table 5-3 Summary of EPD Routine Water Quality Monitoring Data in Deep Bay WCZ Between 2015 and 2019

WATER QUALITY PARAMETER	STATION DM1			STATION DM2			STATION DM3			STATION DM4			STATION DM5		
	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX
Temperature (^oC)	25.4	24.3	26.0	25.3	24.4	26.0	25.2	24.3	25.7	25.0	24.3	25.4	24.7	24.1	25.0
Salinity	13.4	10.8	15.2	15.2	12.1	16.7	19.7	17.7	21.3	21.3	19.9	22.7	24.0	22.8	25.9
Dissolved Oxygen (mg/L)	4.8	4.5	5.5	5.2	4.9	5.8	5.8	5.5	6.4	5.9	5.7	6.1	6.0	5.8	6.1
Bottom	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	5.8	5.6	6.0	5.8	5.8	5.9
Dissolved Oxygen (% Saturation)	63	58	72	69	63	78	79	75	87	80	76	83	82	79	84
Bottom	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	79	75	82	80	79	82
pH	7.2	7.1	7.5	7.4	7.2	7.7	7.6	7.4	7.8	7.7	7.6	7.9	7.8	7.7	7.9
Suspended Solid (mg/L)	49.2	39.9	69.3	38.3	28.7	47.6	13.7	11.6	16.5	9.6	8.0	11.8	7.5	5.7	8.9
5-day Biochemical Oxygen Demand (mg/L)	3.2	1.9	4.3	2.6	1.5	3.5	1.1	0.6	1.2	0.8	0.6	1.1	0.9	0.6	1.1
Unionised Ammonia (mg/L)	0.013	0.007	0.018	0.012	0.005	0.019	0.004	0.002	0.006	0.004	0.002	0.005	0.013	0.002	0.050
Total Inorganic Nitrogen (mg/L)	2.74	2.16	3.10	2.16	1.75	2.34	1.29	1.10	1.43	1.08	0.89	1.25	0.88	0.71	1.07
Total Nitrogen (mg/L)	3.77	2.75	4.70	2.87	2.23	3.52	1.60	1.45	1.76	1.33	1.18	1.57	1.12	0.96	1.35
Chlorophyll-a (µg/L)	10.0	4.4	19.6	9.8	5.1	19.3	4.3	2.7	7.5	2.8	2.0	3.9	2.7	2.0	3.5
E.coli (cfu/100mL)	4170	760	14000	1256	340	4500	48.8	11	140	95	27	210	268	92	350

Source: Compiled from Appendix B of *Marine Water Quality in Hong Kong* from 2015 to 2019, published by EPD.

Notes:

1. For Station location, please see ***Figure 5-1***.
2. Data presented is the depth-averaged value averaged over 5 years, unless stated otherwise.
3. Total Inorganic Nitrogen and Unionised Ammonia is presented as the depth averaged annual mean over 5 years and the depth averaged annual range.
4. *E.coli* is presented as depth averaged annual geometric mean.
5. N.M. – not measured.

Gei Wai

5.3.8 At the seaward side of the gei wai, a sluice gate connecting the inter-tidal outlet allows water to flushing in and out of the gei wai according to the tide. The opening and closing of the sluice gate is controlled by placing wooden sluice boards at the gate. During high tide in Deep Bay, brackish water can enter the gei wai through the sluice gate via the inter-tidal outlet. During low tide water in the gei wai can be drained out.

5.3.9 From September to November (Autumn), and from March to May (Spring) in the Lunar calendar, the inter-tidal mangrove in Deep Bay that borders MPNR is a natural nursery for shrimp and fish. During high tide at these times, the gei wai operators fully open the sluice gate to allow brackish water to flushing into the gei wai, bringing in the shrimp and fish larvae. Fallen leaves of the mangrove decompose in the gei wai and become organic nutrients that shrimp and fish can feed on. Harvesting is normally carried out at night during low tide, when the gei wai operators fully open the sluice gate to allow water from the gei wai to drain out into Deep Bay, catching shrimp and fish in a net placed at the entrance of the sluice gate.

5.3.10 At the end of the harvesting season, gei wai operators will fully drain down the gei wai so that the bacteria in the sediment will be killed by the ultraviolet sunlight. The drain-down process creates areas of shallow water with exposed mud on the gei wai floor that provide feeding and roosting habitat for hundreds of fish-eating birds, particularly herons, egrets and the endangered Black-faced Spoonbill.

5.3.11 It is through the regular water exchange and gei wai drain-down that any pollutants present in the waters of the gei wai can then enter Deep Bay.

5.3.12 In terms of existing water quality within gei wai, WWF carry out routine monitoring of a range of parameters, including salinity, pH, dissolved oxygen and temperature. Monitoring results are shown in graphical form in ***Figures 5-2 to 5-5*** and have been summarised in tabular form in ***Appendix B***.

5.3.13 It can be seen that while there is not much variation in water temperature between gei wai (i.e. difference between the maximum and minimum values is fairly constant) the other parameters vary quite significantly between gei wai and also over time.

Other Water Systems and Sensitive Receivers

5.3.14 A number of natural watercourses of varying sizes run through the Assessment Area, connecting different types of wetland habitats and providing drainage to the area. The most important watercourse is the Shan Pui River that flows from Fairview Park, around the southeast boundary of MPNR and then between the Reserve and Lut Chau, before joining the Kam Tin River in the extreme southeast of the Assessment Area. In addition, two smaller watercourses discharge into the Shenzhen River to the north of Tam Kon Chau.

5.3.15 The only channelised watercourse in the Assessment Area is located in the Fairview Park estate. Despite its downstream connection with a natural watercourse, the artificial features of the concrete channel section severely limit its ecological value and potential.

5.3.16 As the location of the Project is at the coast, no adverse water quality impact is anticipated on the inland, upstream water systems. Thus, the Project will not affect existing nearby uses, such as Fairview Park, Palm Springs and Royal Palms, nor future developments, such as those at Wo Shang Wai, Yau Mei San and East of Kam Pok Road.

5.3.17 Surrounding the Project Site, there are also a number of commercial fishponds while the Site itself is located within the Mai Po Marshes SSSI and the Inner Deep Bay SSSI is located west of the Project Site. The identified water sensitive recievers (WSRs) are summaried in ***Table 5-4*** and their locations are shown in ***Figure 5-6***.

5.3.18 Potential impacts to the commercial fish ponds that abut the Project Site Boundary are discussed in the Fisheries Impact Assessment in ***Section 8***.

Table 5-4 Representative WSRs

WSR ID	WSR	DESCRIPTION
WSR 1	Deep Bay	One of the WCZs and an ecologically important bay, with extensive intertidal mudflats backed by mangal, tidal gei wai and fishponds
WSR 2	Gei Wai Within The Site	Man-made tidal ponds that provide organic nutrients on which shrimp and fish can feed on, and provide feeding and roosting habitat for hundreds of fish-eating birds
WSR 3	Shan Pui River	Flows from Fairview Park, around the southeast boundary of MPNR and then between the Reserve and Lut Chau, before joining the Kam Tin River in the extreme southeast of the Assessment Area.
WSR 4	Watercourses discharging into the Shenzhen River	Smaller watercourses discharge into the Shenzhen River to the north of Tam Kon Chau.
WSR 5	Channelised Watercourse	Located in the Fairview Park estate.
WSR 6	Commercial Fishponds	Commercial fishponds within the Assessment Area.
WSR 7	Mai Po Marshes SSSI	SSSI including the Project Site and south of the Project Site.
WSR 8	Inner Deep Bay SSSI	SSSI located west of the Project Site.

5.4 Potential Impacts and Assessment – Construction Stage

5.4.1 The construction and operation of the Project will not result in the alternation of any water courses, natural streams, ponds, change of water holding/flow regimes, change of catchment types or areas, erosion or sedimentation. There will be no hydrological change due to the construction and operation of the Project.

Typical Pollution Sources

5.4.2 For a typical construction site, water quality impacts can arise from the following:

- General construction activities.
- Construction site runoff.
- Construction works near Waterbodies.
- Accidental spillage.
- Sewage effluent from construction workforce.

General Construction Activities

5.4.3 Construction works have the potential to cause water pollution if not carefully managed. Various types of construction activities may generate wastewater, including general cleaning and polishing, wheel washing, dust suppression and utility installation. These types of wastewater could contain high concentrations of SS. Various construction works may also generate debris and rubbish, such as packaging, construction materials and refuse. Uncontrolled discharge of site effluents, rubbish and refuse generated from the construction works would lead to deterioration in local water quality.

Construction Site Runoff

5.4.4 Surface runoff generated from the construction site may contain increased loading of SS and contaminants. Potential pollution sources of site runoff may include:

- Runoff and erosion of exposed bare soil and earth, drainage channel, earth working area and stockpiles.

5.4.5 During rainstorms, site runoff would wash away soil particles on work areas and areas with the topsoil exposed. Construction runoff is generally characterised by high concentrations of SS. Release of uncontrolled site runoff would therefore increase SS levels, turbidity and cause

depletion of dissolved oxygen levels in nearby water bodies. Site runoff may also wash away contaminants and therefore cause water pollution.

5.4.6 Windblown dust could be generated from exposed soil surfaces in the works areas and it is possible that windblown dust could fall directly onto the nearby water bodies when a strong wind occurs. Dispersion of dust within the works areas may increase the SS levels in surface runoff causing a potential impact to the nearby sensitive receivers.

Construction Works near Water Bodies

5.4.7 Pollution of inland waters may occur due to potential release of construction wastes and wastewater from the adjacent works area. Construction wastes and wastewater are generally characterised by high concentrations of SS and elevated pH.

Accidental Spillage

5.4.8 The use of chemicals, such as engine oil and lubricants, and their storage as waste materials has the potential to create impacts on the water quality if spillage occurs and enters adjacent water bodies. Waste oil may infiltrate into the surface soil layer, or runoff into the nearby water bodies, increasing hydrocarbon levels.

Sewage Effluent from Construction Workforce

5.4.9 During construction of a project, the workforce on site will generate sewage, which is characterized by high levels of BOD, ammonia and E. coli counts. Based on the *DSD Sewerage Manual*, the sewage production rate for construction workers is estimated at 0.35m^3 per worker per day. Thus, for every 100 construction workers working simultaneously at the construction site, about 35m^3 of sewage would be generated per day. Potential water quality impacts upon the local drainage and fresh water system may arise from these sewage effluents, if uncontrolled.

Traditional Approach to Controlling Pollutants

5.4.10 Traditionally, construction sites have collected muddy/contaminated water from perimeter drains and treated it in sedimentation tanks prior to discharge to municipal drains or to local water courses. However, during intense rainfall or typhoon conditions, the site drainage systems are inevitably overwhelmed by the sheer volume of rainfall and muddy/contaminated water then discharges, untreated, from the site.

5.4.11 In less ecologically sensitive areas there is unlikely to be any lasting damage from this discharge, but this Project is located in a Ramsar Site, one of the most ecologically valuable and sensitive wetlands in Hong Kong. Any leakage or discharge of muddy/ contaminated surface water from works areas could quickly enter a gei wai. Not only is there the possibility of direct impacts to the gei wai themselves, but due to the normal water exchange process, pollutants could also enter Deep Bay and induce secondary impacts there. This risk is not acceptable to WWF.

Zero Water Pollution – the WWF Approach

5.4.12 Given that traditional approaches for control of water quality on construction sites are not sufficient for this Project, an alternative approach must be found. Particularly since the work sites are adjacent to water bodies, where any runoff containing pollutants would end up, and from there may ultimately flow into Deep Bay.

5.4.13 One approach is to attempt full containment of all runoff from each works area to prevent it from entering adjacent water bodies. In theory, this could be achieved by provision of tall bunds or double bunds to contain rainwater, but it is unrealistic to expect the Works Contractor to guarantee full containment of water within each works area, irrespective of rainfall – water will inevitably overflow during severe rainstorms. Also, the muddy/contaminated water contained within the bunds would then need to be treated somehow and the effluent discharged. Within MPNR, there are no public drains and all water bodies have high ecological value, therefore even the discharge of treated effluent from the works site is not acceptable to WWF.

5.4.14 It is not considered practicable or desirable to implement "end of pipe" solutions such as these to protect gei wai from pollution and protect Deep Bay from "polluted" gei wai. The better solution is to ensure that the gei wai never become polluted due to Project activities in the first place. Indeed, this is the only way to avoid water quality impacts and ensure that aquatic species are protected, both in the gei wai and in Deep Bay.

5.4.15 This "Zero Water Pollution" approach adopted by WWF relies on two key elements; avoiding pollution of adjacent gei wai and Deep Bay; and avoiding generating polluted runoff from works areas in the first place.

Avoiding Pollution of Adjacent Gei Wai and Deep Bay

5.4.16 As discussed in ***Section 2.3***, specific gei wai within MPNR are drained each year in accordance with the planned schedule set out in the five-year *MPNR Management Plan*. The drained gei wai undergoing such maintenance are not hydraulically connected to any other gei wai nor to Deep Bay, i.e. they are fully isolated from surrounding water bodies. The foundation works for TH2 and TH3 will involve earthworks and because of this, can only be carried out when the adjacent gei wai have been fully drained so as to avoid water seepage and destabilising the bunds.

5.4.17 The "Zero Water Pollution" approach aligns the schedule of foundation works at TH2 and TH3 with the schedule of draining the adjacent gei wai set out in the *MPNR Management Plan 2019-2024*, thereby making use of the hydraulic isolation to avoid pollution of other gei wai and Deep Bay. A perimeter bund will be constructed around the TH2 and TH3 work sites to ensure that any runoff generated from within these sites is discharged only into the adjacent drained gei wai and does not discharge into any other water-filled gei wai.

5.4.18 It should be reiterated that the drain-down of gei wai according to the *MPNR Management Plan 2019-2024* would occur anyway, with or without the Project. WWF is simply making use of the planned draining of gei wai to avoid any additional water quality impact to MPNR due to construction of the Project.

5.4.19 Construction of TH2 and TH3 will require the temporary drain-down of Pond 19 and 20e (TH2) and 8a and GW 7 (TH3). This drain-down will be conducted during the first wet season of the construction phase in accordance with the rolling pond and gei wai desilting programme specified in the *MPNR Management Plan 2019-2024*, hence does not comprise additional impact arising from the Project. Water levels will be restored to normal dry season operating levels at the end of the wet season.

5.4.20 It should be noted that the drain-down of gei wai does provide a benefit to MPNR. In terms of water quality, draining the gei way enables bacteria in the bottom soil to be killed by ultraviolet sunlight. There are also ecological benefits in terms of providing feeding and roosting habitat for hundreds of fish-eating birds.

5.4.21 So although foundation works are a potentially polluting period during construction in terms of runoff, during this period there will in fact be no water in the adjacent gei wai. With no water in the adjacent gei wai, it will not be possible for any contaminants from the works (which are not anticipated anyway, as explained below) to flow into other gei wai or, ultimately, flow into Deep Bay. Hence, full hydraulic isolation is achieved and maintained throughout the entire period of foundation works and therefore water quality impact is avoided.

5.4.22 To order to avoid adverse water quality impact in the event of adverse weather conditions such as heavy rainfall, a perimeter bund shall be constructed around the work sites for TH2 and TH3 to ensure that any runoff generated from these sites is discharged only into the adjacent drained gei wai and not into any other water-filled gei wai that are hydraulically connected to each other and to Deep Bay. Runoff is therefore prevented from entering other water-filled gei wai and Deep Bay and so potential pollution of these water bodies is avoided. Also, materials, plant or equipment that could give rise to contaminated runoff during extreme rainfall will be protected by being covered, either by tarpaulin or by small gazebos that can be erected and folded up within a few minutes.

5.4.23 Any increase in accumulated material at the base of the drained gei wai due to runoff from the TH2 and TH3 work sites will be negligible in comparison to that generated by the maintenance works themselves and will not be discernible. As the gei wai are gradually refilled according to the schedule set out in the *MPNR Management Plan 2019-2024*, suspension of sediment will occur as usual. But since water will be flowing into the previously drained gei wai from the adjacent filled gei wai, there will be no escape of any suspended sediments against the flow of incoming water. When the previously drained gei wai have fully refilled, suspended sediments will settle and the previously drained gei wai will reconnect hydraulically with the surrounding water bodies. Throughout this process, there will have been no adverse impact on water quality of the surrounding gei wai or Deep Bay from the works that were carried out at TH2 and TH3.

5.4.24 The new Boardwalks are generally at some distance from water bodies and does not require any excavation work, and so no muddy run-off is expected. As such, no impact on gei wai or on Deep Bay is anticipated from construction of the Boardwalks.

Avoiding Polluted Runoff from Works Areas

5.4.25 For the gei wai within MPNR and Deep Bay to become polluted as a result of contaminated run-off from the works sites within MPNR, there would need to be a hydraulic connection through which the pollutants could travel, i.e. through the gei wai adjacent to the work sites. However, as explained above, this will not be the case, and any polluted runoff from works areas will be isolated from the rest of the gei wai and from Deep Bay.

5.4.26 The specific construction methods and configurations for the three Project Elements were described in ***Section 2.2***. From this, it can be seen that potential water quality impacts could result from runoff from works areas that is contaminated due to the presence of temporary stockpiles of soil excavated for the foundations of TH2 and TH3 (mud); the presence of concrete for construction of the footings of TH2 and TH3 (concrete washings); cleaning and maintenance of plant and equipment (oily wastes); and general site waste (refuse from construction packaging and sewage from workers).

5.4.27 To further ensure that there is “Zero Water Pollution” from the works areas, the following additional measures will be adopted by WWF, its Designers and its Works Contractors:

- **Perimeter Bund.** A perimeter bund shall be constructed around the work sites for TH2 and TH3 to ensure that any runoff generated from these sites is discharged only into the adjacent drained gei wai and not into any other water-filled gei wai that are hydraulically connected to each other and to Deep Bay. Runoff is therefore prevented from entering other water-filled gei wai and Deep Bay and so potential pollution of these water bodies is avoided. Suggested positions for these bunds are shown in ***Figures 2-4 and 2-5***.
- **Off-site Pre-fabrication.** The majority of construction components shall be pre-fabricated off-site to avoid adverse impacts associated with construction on-site. With this approach, the construction activities will mainly involve assembly of pre-fabricated components.
- **Off-site Concrete Mixing.** One of the main sources of contaminated runoff from construction sites is concrete washings from concrete mixing on site. To avoid this problem, all concrete will be mixed off-site and brought into each works area only when needed and only in the quantities required, so that there is no need to store (or dispose of) any surplus concrete. Any concrete spilled within the works area will be immediately cleaned up and removed from the works area.
- **Off-site Maintenance/Repair of Plant**. Plant, equipment and vehicles shall not be maintained or repaired within any works area in the Project Site. Instead, all such servicing shall be undertaken off-site, such that any resulting oil, chemical waste or other polluting substances can be handled and treated off-site in an appropriate manner.
- **Extreme Care When Re-fuelling Plant.** In the event that non-mobile plant and equipment require re-fuelling, and it is not practicable to move off-site for re-fuelling, then re-fuelling shall be carried out with extreme care. Drip trays shall be provided at any fuel connection

point, e.g. between the delivery pipe and the fuel tank. Any spilled fuel shall be collected and taken off-site for proper treatment/disposal.

- **Covering Materials, Plant and Equipment During Rainstorms.** Materials, plant or equipment that could give rise to contaminated runoff during extreme rainfall will be protected by being covered, either by tarpaulin or by small gazebos that can be erected and folded up within a few minutes.
- **Provision of Chemical Toilets.** Each works area will be provided with at least one chemical toilet for use by workers. Sewage collected in these chemical toilets will be treated off-site by the toilet provider.
- **Bunded, Covered C&D Material Storage Areas.** Each works area will be provided one bunded and covered area for the temporary storage of C&D material – one section for inert C&D material and one area for C&D waste. These areas will be emptied frequently, using construction material delivery vehicles that are empty on their return journey. All inert C&D material and C&D waste will be transported off-site for recycling or treatment as appropriate.
- **Waterproof General Waste Receptacles.** Each works area will be provided with at least one set of waterproof waste receptacles – one for recyclable waste and one for non-recyclable waste. These receptacles will be emptied frequently.

5.4.28 In addition to the above, the Works Contractor shall follow good site practice (as discussed in ***Section 5.6***, below) and shall be responsible for the design construction, operation and maintenance of relevant mitigation measures specified in *ProPECC PN 1/94* for construction site drainage. Specified good site practice and code of behaviour shall be included in the works contract documents.

5.4.29 With the above measures in place – and regularly checked/audited by the Environmental Team (ET) and the Independent Environmental Checker (IEC) – there will be no point or non-point pollution sources due to the construction of the Project. Other than the control measures proposed above, no facilities, plant or equipment will be required to reduce pollution arising from the point and non-point sources, as there will be no pollution. Runoff from works areas will not enter surrounding water bodies, only the adjacent drained gai wai, and so there can be no pollution of fishponds or full gei wai and, consequently, no pollution of Deep Bay.

Zero Water Pollution – Conclusion

5.4.30 So, for this Project, the preferred approach to water quality management is not to attempt to control runoff or use an “end of pipe” solution, but effectively prevent adverse impact to surrounding gei wai and Deep Bay by ensuring that there is no hydraulic connection between the works areas and sensitive water bodies. Additionally, by adopting a more stringent approach to design, construction and site management, the chance of pollutants being generated in the first place is further reduced.

5.4.31 As there will be no pollution sources due to the construction of the Project entering the environment of MPNR, no adverse water quality impact is anticipated on the water systems – gei wai or Deep Bay – or associated sensitive receivers. There will be no alteration of any water courses, natural streams, ponds, change of water holding/flow regimes, change of catchment types or areas, erosion or sedimentation. There will be no change to the hydrology within the Project Site or within the Assessment Area for water quality; there will be no release of contaminants, such as fuel oil or chemicals, since none will be permitted on site; and there will be no land decontamination required.

5.4.32 The above measures will result in zero polluted runoff from the works areas entering surrounding water bodies. After refilling of the gei wai there will not be any residual impact due to construction of the Project and the Project will not hinder the attainment of the WQOs for the Deep Bay WCZ.

5.4.33 Given that there will no pollution sources – point or non-point – due to the construction of the Project entering the environment of MPNR and given that the draining of the gei wai adjacent to

the works areas for the tower hides effectively isolates these areas from the surrounding water bodies, there is no possibility of any water pollution due to the Project entering Deep Bay. Therefore, it is not possible (and indeed not necessary) to carry out water quality modelling in this regard – simply put, the "Zero Water Pollution" approach ensures that there will be no impact.

Cumulative Impact

5.4.34 The demolition and rebuild of PSFSC near MPNR will have been completed by March 2022 whereas the construction of this Project will not commence until end-April 2022. As such, the demolition and rebuild of PSFSC will not be carried out concurrently with this Project. There are also no other concurrent projects near MPNR. Thus, cumulative water quality impacts for this Project is not anticipated.

5.4.35 As shown in the Project Programme in ***Figure 2-6***, there are also no concurrent works related to the *MPNR Management Plan 2019-2024* and so no cumulative water quality impacts.

5.4.36 As the "Zero Water Pollution" approach will ensure that this Project will not cause pollution of gei wai, or water courses, natural streams, and ponds that discharge into Deep Bay, there is no contribution from this Project to cumulative water quality impacts within the Assessment Area.

5.5 Potential Impacts and Assessment – Operation Stage

5.5.1 The two new tower hides will not be provided with toilets or washrooms and so no wastewater will be generated. Runoff from the roof of the tower hides and from the footpaths will not be contaminated. As such, there will be no point or non-point pollution sources due to the operation of the Project and therefore no impact to the water systems – gei wai or Deep Bay – or associated sensitive receivers within the Project Site or within the Assessment Area for water quality.

5.5.2 Overall, therefore, no adverse water quality impact is anticipated during operation stage.

5.6 Mitigation Measures

Construction Stage

5.6.1 Zero polluted runoff from works areas (as described in ***Section 5.4***) shall be achieved by programming the construction of footings/substructure at TH2 and TH3 only when the adjacent gei wai are drained in accordance with the *MPNR Management Plan 2019-2024* and also through the implementation of:

- Perimeter Bund
- Off-site Pre-fabrication
- Off-site Concrete Mixing
- Off-site Maintenance/Repair of Plant
- Extreme Care When Re-fuelling Plant
- Covering Materials, Plant and Equipment During Rainstorms
- Provision of Chemical Toilets
- Bunded, Covered Construction C&D Material Storage Areas
- Waterproof General Waste Receptacles

5.6.2 In addition to the above, the Works Contractor shall follow good site practice and be responsible for the design construction, operation and maintenance of applicable mitigation measures specified in *ProPECC PN 1/94* for construction site drainage:

- Perimeter channels at site boundaries shall be provided to intercept surface runoff from outside the works areas so that it will not wash across the works areas and to direct all site runoff only into adjacent drained gei wai.
- For the purpose of preventing soil erosion, exposed slope surfaces shall be covered e.g. by tarpaulin, and temporary access roads shall be protected by crushed stone or gravel.
- Intercepting channels shall be provided (e.g. along the crest/edge of excavation) to prevent storm runoff from washing across exposed soil surfaces. Arrangements shall always be in place

to ensure that adequate surface protection measures can be safely carried out well before the arrival of a rainstorm.

- Earthworks final surfaces shall be well compacted and the subsequent permanent work or surface protection shall be carried out immediately after the final surfaces are formed to prevent erosion caused by rainstorms.
- Measures shall be taken to minimise the ingress of rainwater into trenches. If excavation of trenches in wet seasons is necessary, they shall be dug and backfilled in short sections.

5.6.3 The Works Contractor(s) shall be required to prepare and implement a risk management plan to minimise risks and to prepare and implement an emergency response plan in case of accident, particularly in works areas close to gei wai and commercial fishponds.

5.6.4 As a precautionary measure, and to demonstrate that the "Zero Water Pollution" approach is working, it is proposed to carry out water quality EM&A within Deep Bay before, during and after the foundation works at TH2 and TH3. Further details are given in ***Section 10.4***.

Operation Stage

5.6.5 No mitigation measures are required during the operation stage.

5.7 Conclusion

5.7.1 WWF will adopt a "Zero Water Pollution" approach during construction, particularly for TH2 and TH3. This relies on two key elements; avoiding pollution of adjacent gei wai and Deep Bay; and avoiding generating polluted runoff from works areas in the first place.

5.7.2 To avoid pollution of adjacent gei wai and Deep Bay, the schedule of foundation works at TH2 and TH3 – the most potentially polluting period during construction in terms of runoff – will be aligned with the schedule of draining the adjacent gei wai in the *MPNR Management Plan 2019-2024.* The drained gei wai undergoing such maintenance are not hydraulically connected to any other gei wai nor to Deep Bay, i.e. they are fully isolated from surrounding water bodies. A perimeter bund will be constructed around the TH2 and TH3 work sites to ensure that any runoff generated from within these sites is discharged only into the adjacent drained gei wai and does not discharge into any other water-filled gei wai. With no water in the adjacent gei wai into which all site runoff will flow, it will not be possible for any contaminants from the works (which are not anticipated anyway) to flow into other gei wai or, ultimately, flow into Deep Bay.

5.7.3 To avoid generating polluted runoff from works areas in the first place, zero contaminated runoff will be achieved through implementation of a series of measures, including off-site pre-fabrication; off-site concrete mixing; off-site maintenance/repair of plant; taking extreme care when re-fuelling plant; covering materials, plant and equipment during rainstorms; provision of chemical toilets; bunded, covered construction C&D material storage areas; and waterproof general waste receptacles.

5.7.4 In addition to this, the Works Contractor shall follow good site practice and be responsible for the design construction, operation and maintenance of applicable mitigation measures specified in ProPECC PN 1/94 for construction site drainage.

5.7.5 With the above measures in place during the construction stage, it is unlikely that there will be adverse water quality impact to the gei wai or to Deep Bay as a result of the works. Furthermore, no cumulative impact is identified. Nevertheless, as a precautionary measure and to demonstrate that the "Zero Water Pollution" approach is working, it is proposed to carry out water quality EM&A within Deep Bay before, during and after the foundation works at TH2 and TH3.

5.7.6 During operation, no adverse water quality impact is anticipated as the two new tower hides will not be provided with toilets or washrooms, and so no wastewater will be generated. Runoff from the roof of the tower hides and from the footpaths will not be contaminated.

5.7.7 Overall, therefore, no adverse water quality impact is anticipated during the construction or operation stages of the Project.

6 WASTE MANAGEMENT IMPLICATIONS

6.1 Introduction

6.1.1 This assessment of waste management implications has been carried out to identify, qualify and quantify solid waste arising from the construction and operation of the Project. The criteria and guidelines listed in Annex 7 and Annex 15 of the EIAO-TM are referred to.

6.1.2 The assessment of waste management implication includes measures proposed for waste avoidance, minimisation, re-use and recycling. Waste management options and potential environmental impacts with the waste handling and disposal options are assessed.

6.2 Legislation, Standards and Guidelines

6.2.1 The principle legislation governing waste management is the *Waste Disposal Ordinance* (WDO) (Cap. 354) and its subsidiary regulations. The WDO generally encompasses all stages of waste management, from place of arising to final disposal point of waste. The *Waste Disposal (Chemical Waste) (General) Regulation*, provides controls on all aspects of chemical waste disposal, including storage, collection, transport, treatment and final disposal.

6.2.2 In carrying out the solid waste assessment, reference has been made to the following relevant legislation, documents and guidelines:

- The WDO setting out requirements for storage, handling and transportation of all types of wastes, and subsidiary legislation such as the *Waste Disposal (Charges for Disposal of Construction Waste) Regulation* and the *Waste Disposal (Chemical Waste) (General) Regulation*
- The *Land (Miscellaneous Provisions) Ordinance* (Cap. 28) setting out requirements for individuals or companies to obtain Dumping Licences for delivering public fill to the public fill reception facilities.
- The *Public Health and Municipal Services Ordinance* (Cap. 132) providing further control on illegal dumping of wastes on unauthorized (unlicensed) site.
- Environmental, Transport and Works Bureau (ETWB) Technical Circular (Works) No. 19/2005, Environmental Management on Construction Sites.
- Environmental, Transport and Works Bureau (ETWB) Technical Circular (Works) No. 22/2003A Additional Measures to Improve Site Cleanliness and Control Mosquito Breeding on Construction Sites.
- Project Administration Handbook for Civil Engineering Works (2014 Edition) – Section 4.1.3
- Development Bureau (DevB) Technical Circular (Works) No. 6/2010, Trip Ticket System for Disposal of Construction & Demolition Materials.
- Practice Note for Registered Contractor No. 17 – Control of Environmental Nuisance from Construction Site.
- Monitoring of Solid Waste in Hong Kong – Waste Statistics for 2019.

6.3 Types of Waste

6.3.1 The following types of waste may be generated during the works such as site clearance, construction of TH2 and TH3 as well as construction of new boardwalks, etc.:

- **Inert C&D Material.** Does not decompose, such as debris, rubble, earth and concrete, and is suitable for land reclamation and site formation. The major source of inert C&D material will be generated from the construction of TH2 and TH3 during the construction stage.
- **C&D Waste (or Non-inert C&D Material).** Can decompose and generate odour, such as bamboo, timber, vegetation, packaging waste and other organic material, and is therefore unsuitable for land reclamation. The major source of non-inert C&D material will be from site clearance for TH2, TH3 and the footpaths during the construction stage.

- **General Refuse.** Municipal Solid Waste (MSW) includes paper, packaging, food waste, etc. arising from workers during the construction stage. There will be no general refuse from visitors during the operation stage because no rubbish bins will be provided within MPNR.
- **Chemical Waste.** Liquid, semi-solid and solid wastes (e.g. waste lube oil, asbestos, etc.) that are hazardous or polluting and must therefore be managed, treated and disposed of in a controlled manner. There will be no chemical waste generated during the construction stage as there shall be no maintenance or repair of vehicles, plant or equipment on site.

6.3.2 The works under the five-year MPNR Management Plan 2019-2024 discussed in Section 2.3 are planned maintenance works for MPNR and do not form part of this Project. No dredging or desilting works are required during the construction and operation of the Project.

6.4 Potential Impacts and Assessment – Construction Stage

6.4.1 To ensure that the inert C&D materials is acceptable at Public Fill Reception Facilities (PFRFs) or for recycling, all waste materials arising from or in connection with the construction work shall be sorted on-site and be separated into different groups for disposal at landfill, PFRFs, or recycling. As a minimum, separation of inert from non-inert materials shall be provided, as research in *A Guide for Managing and Minimizing Building and Demolition Waste* (*"the Guide"*)[Ref.#6] indicates that 90% of construction waste produced could be used for reclamation if sorting is performed.

Inert C&D Material

6.4.2 Section 3.2 of *The Guide* provides a "waste index" for building waste generation in Hong Kong based on the GFA of three different building types:

Private Housing Projects	$0.250m^3/m^2$ GFA
Government Housing Projects	$0.174m^3/m^2$ GFA
Commercial Office Projects	$0.200m^3/m^2$ GFA

6.4.3 To provide an estimate of building waste from the construction of the new tower hides, the "waste index" for commercial office projects has been used, which is the closest fit to the tower hides. However, this index does not truly reflect the simple design of the tower hides and does not take into account the pre-fabrication approach that will be used for construction of the tower hides. As such, calculations using the above factors are considered to be very conservative.

6.4.4 In addition to inert C&D material, this "waste index" also includes C&D waste but *The Guide* does not identify what proportion of building waste is inert C&D material and what proportion is C&D waste. However, Plate 2.12 of *Monitoring of Solid Waste in Hong Kong – Waste Statistics for 2019*[Ref.#7] identifies that in 2019, 92% of construction waste was public fill sent to PFRFs or transferred to projects for beneficial reuse. In line with this, 92% of the total construction waste to be generated during construction of this Project is also assumed to be public fill (inert materials).

6.4.5 The proportion of inert C&D material in the "waste index" can therefore be estimated by applying the Hong Kong-wide proportion of inert C&D material in construction waste, i.e. 92%, to the "waste index" as follows:

$$\text{Waste Index}_{\text{INERT C\&D MATERIAL}} = 0.92 \times \text{“waste index” for commercial office projects}$$
$$= 0.92 \times 0.200m^3/m^2 \text{ GFA}$$
$$= 0.184m^3/m^2 \text{ GFA}$$

6. *A Guide for Managing and Minimizing Building and Demolition Waste*, C. S. Poon, T.W. Yu and L. H. Ng, Research Centre for Urban Environmental Technology and Management, Department of Civil and Structural Engineering, The Hong Kong Polytechnic University, May 2001.

7. *Monitoring of Solid Waste in Hong Kong – Waste Statistics for 2019*, EPD, December 2020.

6.4.6 There will be some excavation work required for the installation of footings for TH2 and TH3, however, all of the excavated soil will be backfilled after completion of the footings and no on-site or off-site disposal or surplus soil will be required. No dredging of mud will be required for the Project.

6.4.7 The inert C&D material component of building waste from the construction of the new tower hides can be calculated as follows, as shown in ***Table 6-1***:

Building Waste = Waste Index$_{\text{INERT C\&D MATERIAL}}$ x GFA

Table 6-1 Estimate of Inert C&D Material Arising During Construction Stage

PROJECT ELEMENT	AREA (m^2)	VOLUME (m^3)	WEIGHT[NOTE 1] (TONNES)	REMARKS
INERT C&D MATERIAL FROM BUILDINGS AND BOARDWALKS				
Construction of TH2	145.0	26.7	48.0	Includes surplus material from foundation excavation
Construction of TH3	145.0	26.7	48.0	
Boardwalks Above Existing Concrete Paths	1,628.6	0.0	0.0	Concrete will remain in situ, no concrete waste will arise
Boardwalks to Access New THs	397.7	0.0	0.0	No excavation required.
Boardwalks for EAs	74.6	0.0	0.0	No excavation required.
Total		**53.4**	**96.0**	

Note:

1. Assume inert C&D material has a density of 1.8 tonnes/m^3.

6.4.8 The 96.0 tonnes inert C&D material equates to 32.0 tonnes per month on average over the three months during which construction will be carried out, equivalent to six trips per month for a 5.5 tonne dump truck. This is a highly conservative estimate and in reality the quantity of waste is likely to be much lower. This waste will be sent to the nearest PFRF, which is at Tuen Mun Area 38, around 16km from the Site.

6.4.9 CEDD *Technical Circular No. 03/2015 Management of Construction and Demolition Materials* requires a project that generates more than 50,000m^3 of C&D material to have a Construction and Demolition Material Management Plan (C&DMMP). As this Project will generate an estimated 53.4m^3 of inert C&D material a C&DMMP will not be required.

6.4.10 In terms of impacts from the handling, transportation or disposal of inert C&D material, there is no potential hazard; no odour emission; no on-site noise other than vehicle movement; and no ecological impact. Dust will be controlled through appropriate methods to be proposed in the Waste Management Plan (WMP); run-off will be controlled; and the use of public roads for transportation is limited, as described above. With proper implementation of good site practices and mitigation measures as recommended in ***Section 6.6***, no adverse environmental impact is anticipated from management of inert C&D materials during the construction stage.

C&D Waste

6.4.11 For building work, C&D waste, such as timber formwork, packaging waste, vegetation from site clearance and other wastes, is included in the "waste index" provided in *The Guide*, together with inert C&D material.

6.4.12 However, Plate 2.12 of *Waste Statistics for 2019* identifies that in 2019, 8% of construction waste was disposed of at landfills, which is assumed as C&D waste. The proportion of C&D waste in the "waste index" can therefore be estimated by applying the Hong Kong-wide proportion of C&D waste in construction waste, i.e. 8%, to the "waste index" as follows:

Waste Index$_{\text{C\&D WASTE}}$ = 0.08 x "waste index"
= 0.08 x 0.200m^3/m^2 GFA
= 0.016m^3/m^2 GFA

6.4.13 The C&D waste component of building waste from the construction of the new components can be calculated as follows:

Building Waste = Waste Index$_{C\&D\ WASTE}$ x GFA

6.4.14 In addition to this, there will be vegetation waste from clearance of each works area. These waste quantities are estimated in ***Table 6-2***:

Table 6-2 Estimate of C&D Waste Arising During Construction Stage

PROJECT ELEMENT	AREA (m^2)	VOLUME (m^3)	WEIGHT[NOTE 1] (TONNES)	REMARKS
C&D WASTE FROM BUILDINGS AND BOARDWALKS				
Construction of TH2	145.0	2.3	4.2	
Construction of TH3	145.0	2.3	4.2	
Boardwalks Above Existing Concrete Paths	1,628.6	4.9	3.7	Assume timber off-cuts at 10% of volume of wood used for 3cm thick decking (includes vertical posts and horizontal bracing)
Boardwalks to Access New Tower Hides	397.7	1.2	0.9	
Boardwalks for EAs	74.6	0.2	0.2	
Total		**10.9**	**13.1**	
VEGETATION FROM SITE CLEARANCE[NOTE2]				
Phase 1 for TH2	835.0	208.8	20.9	
Phase 1 for TH3	940.0	235.0	23.5	
Boardwalks Above Existing Concrete Paths	3,109.1	777.3	77.7	Excludes 1,480.5m^2 of existing concrete footpaths
Boardwalks to Access New Tower Hides	1,120.7	280.2	28.0	
Boardwalks for EAs	299.4	74.9	7.5	Excludes areas overlapping with adjacent boardwalk of main footpath
Total		**1,576.0**	**157.6**	

Notes:

1. Assume C&D waste has a density of 1.8 tonnes/m^3. Assume of wood (boardwalk off-cuts) has a typical density of 0.75 tonnes/m^3. Assume vegetation (compressed) has a density of 0.1 tonnes/m^3.
2. Vegetation from site clearance assumed to be 0.25m^3 per m^2 based on typical vegetation cover).

6.4.15 The 13.1 tonnes of C&D waste that requires off-site disposal equates to 4.4 tonnes per month on average over the three months during which construction will be carried out, equivalent to one trip per month for a 5.5 tonne dump truck. The 157.6 tonnes of vegetation waste will be reduced in size to aid biodegradation and then all will be composted within MPNR – it will not require off-site disposal.

6.4.16 On-site sorting should be carried out for the other C&D waste generated from the construction works. Recyclable materials, such as metal, paper products, timber and plastic, should be collected by local recyclers for off-site recycling. Plate 3.1 in *Waste Statistics for 2019* identified that 29% of MSW was recovered in 2019. Assuming a similar recovery rate for C&D waste, this could be around 3.8 tonnes. Landfill disposal of the remaining 71%, or 9.3 tonnes, should be adopted as the last resort. The nearest disposal facility is NENT Landfill, which is 22km from the Site.

6.4.17 It is estimated that there will be 4.4 tonnes per month of C&D waste generated. Nevertheless, to minimise waste generation mitigation measures proposed below should be implemented.

6.4.18 In terms of impacts from the handling, transportation or disposal of C&D waste, there is no potential hazard; no odour emission; no on-site noise other than vehicle movement; and no ecological impact. Dust will be controlled through methods to be proposed in the WMP; run-off will be controlled; and the use of public roads for transportation is limited, as described above.

With proper implementation of good site practices and mitigation measures as recommended in ***Section 6.6***, no adverse environmental impact is anticipated from management of C&D waste during the construction stage.

General Refuse

6.4.19 General refuse from construction workers is similar to domestic waste and includes packaging and organic material. The numbers of workers who will be engaged on the construction works will depend on which contractor is engaged to carry out the work. However, based on industry experience, we estimate for a project of this size there would be no more than 100 workers per day over the six months during which construction will be carried out.

6.4.20 Each construction worker will generate general refuse, which is similar to domestic waste. Plate 2.7 of *Waste Statistics for 2019* identifies that the per capita domestic waste disposal rate in 2019 was 0.87kg/person/day. Although the per worker generation rate of general refuse will be less than this, to be conservative the per capita domestic waste disposal rate in 2019 has been adopted for general refuse generation by construction workers. On this basis:

General Refuse/day	= No. workers/day x per capita generation rate
	= 100 workers x 0.87kg/worker/day
	= 87kg/day
Total General Refuse	= General Refuse/day x duration of construction contract
	= 87kg/day x (6 days/week x 6 months)
	= 13,572kg
	= 13.6 tonnes

6.4.21 The 13.6 tonnes of general refuse equates to 4.5 tonnes per month on average over the three months during which construction will be carried out, equivalent to one trip per month for a 5.5 tonne dump truck/flatbed/refuse collection vehicle.

6.4.22 On-site sorting should be carried out, with recyclable materials, such as metal, paper and plastic, given to local recyclers for off-site recycling. Based on the 29% recovery rate for MSW achieved in Hong Kong in 2019, as shown on Plate 3.2 in *Waste Statistics for 2019*, this could be around 3.9 tonnes. Landfill disposal of the remaining 71%, or 9.7 tonnes, should be adopted as the last resort. The nearest disposal facility for general waste is the NWNT Transfer Station in Yuen Long, around 18km from the Site, equivalent to one trip per month for a 5.5 tonne dump truck.

6.4.23 It is estimated that there will be 4.5 tonnes per month of general refuse generated. Nevertheless, to minimise waste generation mitigation measures proposed below should be implemented.

6.4.24 In terms of impacts from the handling, transportation or disposal of general refuse, there is no potential hazard; no dust emissions; no on-site noise other than vehicle movement; and no ecological impact. Odour will be controlled through appropriate methods to be proposed in the WMP; run-off will be controlled as per the ***8th Bullet under paragraph 5.4.25***; and the use of public roads for transportation is limited, as described above. With proper implementation of good site practices and mitigation measures as recommended in ***Section 6.6***, no adverse environmental impact is anticipated from management of general refuse during the construction stage.

Chemical Waste

6.4.25 Chemical waste that typically arises during construction on other projects includes spent lubricants, waste batteries, etc. from vehicles, plant and equipment that are maintained on site. For the Mai Po Nature Reserve Infrastructure Upgrade Project, however, WWF will mandate in all contract documents that there shall be no maintenance or repair of vehicles, plant or equipment on site. On this basis, therefore, no chemical waste is anticipated to arise during the construction stage.

6.5 Potential Impacts and Assessment – Operation Stage

6.5.1 Inert C&D Material, C&D Waste and Chemical Waste are not anticipated to be generated during operation of the Project.

6.5.2 General refuse may be generated by visitors but to minimise the amount WWF will continue to encourage visitors to bring their own reusable water bottles and food containers, rather than single-use containers, and to provide free drinking water for visitors at the MPEC.

6.5.3 No waste receptacles are provided within MPNR and visitors will be encouraged to take their waste home with them. As such there will be no general waste deposited within MPNR during operation. Outside the Project Site, at PSFSC, recycling bins will be provided for visitors before and after their visit to the MPNR.

6.5.4 As no waste receptacles are provided within MPNR, visitors deposit any waste in recycling bins outside the MPNR that are provided by WWF. According to WWF's records, the general refuse collected in 2018 was between 5kg and 7kg per day, which around 0.09kg per person per day.

6.5.5 WWF estimates that visitor numbers will increase 32,800 per year within three years after the Mai Po Nature Reserve Infrastructure Upgrade Project is completed:

No. Future Visitors	= 32,800 visitors per year
Refuse per Visitor	= 0.09 kg per visitor per year on average (based on 2018 rate)
Predicted Refuse	= 2,981kg per year
	= 248kg per month
	= 8kg per day

6.5.6 This waste will not be disposed of within the Project Site but in recycling bins outside the MPNR.

6.6 Mitigation Measures

Construction Stage

6.6.1 Waste management shall be controlled through contractual requirements as well as through statutory requirements, including:

- Environmental, Transport and Works Bureau (ETWB) Technical Circular (Works) No. 19/2005, Environmental Management on Construction Sites
- Project Administration Handbook for Civil Engineering Works (PAH) Section 4.13
- Development Bureau (DevB) Technical Circular (Works) No. 6/2010, Trip Ticket System for Disposal of Construction & Demolition Materials

6.6.2 According to ETWB TC(W) No. 19/2005, the Waste Management Plan (WMP) becomes part of the Environmental Management Plan that should be developed by the contractor and to be submitted to Architect/Engineer for approval before the commencement of any demolition or construction works. The objectives of the WMP will be to identify any potential environmental impacts from the generation of waste at the Site; to recommend appropriate waste handling, collection, sorting, disposal and recycling measures in accordance with requirements of the current regulations; and to categorise and permit segregation of C&D material (i.e. inert C&D materials, C&D waste, etc. for off-site reuse, recycling, treatment and/or disposal.

6.6.3 The contractors should adopt good housekeeping practices with reference to the WMP such as waste segregation prior to disposal. Besides the provision of stockpiling and segregating areas at site, effective collection of site wastes is required to prevent waste materials being blown around by wind, flushed or leached into nearby waters, or creating odour nuisance or pest and vermin problems. Waste storage areas should be well maintained and cleaned regularly.

6.6.4 Mitigation measures listed in Practice Note for Registered Contractors No. 17 *Control of Environmental Nuisance from Construction Sites* shall be adopted. C&D Material shall be delivered to the appropriate designated outlets by dump trucks fitted with covered box type dump bed and such dump trunks shall comply with the particular specification listed in Part B of

Annex 2 to Appendix C of ETWB TC(W) No. 19/2005 to minimise potential nuisance during transportation of waste. Refuse pending removal should be stored in receptacles provided with close fitting covers to avoid waste materials be flushed or leached under inclement weather conditions such as heavy rainfall.

6.6.5 A trip-ticket system shall be established in as per DevB TC(W) No. 6/2010 and the *Waste Disposal (Charges for Disposal of Construction Waste) Regulation* to monitor the disposal of public fill and solid waste at PFRFs and landfills, and to control fly-tipping. A trip-ticket system shall be included as one of the contractual requirements for the contractor to strictly implement.

6.6.6 General refuse should be stored in enclosed bins or compaction units separate from C&D material. A reputable waste collector should be employed by the construction contractor to remove general refuse from the Site, separately from C&D materials. Preferably an enclosed and covered area should be provided to reduce the occurrence of “wind-blown” materials.

6.6.7 The Contractor should adopt good working practices in order to further minimise the environmental impacts related to waste arising from the Project, such as:

- The Contractor shall observe and comply with the *Waste Disposal Ordinance* and its subsidiary regulations.
- The Contractor shall submit to the Engineer for approval a WMP with appropriate mitigation measures including allocation of an area for waste segregation and shall ensure that the day-to-day site operations comply with the approved WMP.
- The Contractor shall minimise the generation of waste from his work. Avoidance and minimisation of waste generation can be achieved through changing or improving design and practices, careful planning and good site management.
- The Contractor shall ensure that different types of wastes are segregated on-site and stored in different containers, skips or stockpiles to facilitate reuse/recycling of waste and, as the last resort, disposal at different outlets as appropriate.
- The reuse and recycling of waste shall be practised as far as possible. The recycled materials shall include paper/cardboard, timber and metal etc.
- The Contractor shall ensure that C&D materials are sorted into public fill (inert portion) and C&D waste (non-inert portion). The public fill, which comprises soil, rock, concrete, brick, cement plaster/mortar, inert building debris, aggregates and asphalt, shall be reused in earth filling, reclamation or site formation works. The C&D waste, which comprises metal, timber, paper, glass, junk and general refuse, shall be reused and recycled and, as the last resort, disposal of at landfills.
- The Contractor shall record the amount of waste generated, recycled and disposed of (including the disposal sites).
- The Contractor shall use a trip ticket system for the disposal of C&D materials to any designated PFRFs and/or landfill.
- Training shall be provided for workers about the concepts of site cleanliness and appropriate waste management procedures, including waste reduction, reuse and recycling.
- The Contractor shall not permit any sewage, wastewater or effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the Site onto any adjoining land or allow any waste matter to be deposited anywhere within the Site or onto any adjoining land. He shall arrange removal of such matter from the site in a proper manner to the satisfaction of the Engineer in consultation with the Director of Environmental Protection.
- The Contractor shall observe and comply with the *Waste Disposal (Chemical Waste) (General) Regulation*.

6.6.8 When inclement weather (e.g. heavy rain, typhoon, etc.) is forecast, additional control measures should be adopted as follows:

- Construction material, stockpiles, chemical and waste storage/recycling facilities should be immediately moved to secured area.
- Construction material, stockpiles and waste storage/recycling facilities should be covered by an impermeable sheeting, if necessary.
- Intercepting channels will be provided at the edge of the excavated area to prevent storm runoff from washing across the exposed surface.

Operation Stage

6.6.9 In order to minimise the amount of waste generated by visitors to MPNR, WWF will continue to encourage visitors to bring their own reusable water bottles and food containers, rather than single-use containers, and to provide free drinking water for visitors at the EC. No waste receptacles are provided within MPNR and visitors will be encouraged to take their waste home with them. As such, no mitigation is required.

6.7 Conclusions

Construction Stage

6.7.1 An estimated 96.0 tonnes of inert C&D material will be generated, which equates to 32.0 tonnes per month on average. This waste will be sent to the PFRF at Tuen Mun Area 38, around 16km from the Site.

6.7.2 An estimated 13.1 tonnes of C&D waste will be generated, which equates to 4.4 tonnes per month on average. An estimated 157.6 tonnes of vegetation waste, which equates to 52.5 tonnes per month on average, will be reduced in size to aid biodegradation and then composted within MPNR – none will require off-site disposal.

6.7.3 On-site sorting should be carried out for the other C&D waste generated from the construction works. Recyclable materials, such as metal, paper products, timber and plastic, should be collected by local recyclers for off-site recycling. Assuming a similar 29% recovery rate for C&D waste as was achieved for MSW in 2019, this could be around 3.8 tonnes. Landfill disposal of the remaining 71%, or 9.3 tonnes, should be adopted as the last resort. The nearest disposal facility is NENT Landfill.

6.7.4 With the on-site biodegradation and composting as well as off-site recycling, the amount of C&D waste required to be disposed of at landfills is minimized.

6.7.5 An estimated 13.6 tonnes of general refuse will be generated, which equates to 4.5 tonnes per month on average. Even if the construction period is longer than assumed, meaning that the quantity of general refuse produced will be larger, it will still be insignificant and the conclusions of this waste assessment will remain unchanged.

6.7.6 On-site sorting of general refuse should be carried out, with recyclable materials, such as metal, paper and plastic, given to local recyclers for off-site recycling. Based on the 29% recovery rate for MSW achieved in Hong Kong in 2019, this could be around 3.9 tonnes. Landfill disposal of the remaining 71%, or 9.7 tonnes, should be adopted as the last resort. The nearest disposal facility for general waste is the NWNT Transfer Station in Yuen Long.

6.7.7 With proper waste segregation and recycling as well as provision of waste management training, the amount of general refuse required to be required of at landfills is minimized.

6.7.8 In terms of chemical waste, WWF will mandate in all contract documents that there shall be no maintenance or repair of vehicles, plant or equipment on site. On this basis, therefore, no chemical waste is anticipated to arise during the construction stage.

Operation Stage

6.7.9 Inert C&D Material, C&D Waste and Chemical Waste are not anticipated to be generated during operation of the Project.

6.7.10 General refuse may be generated by visitors but to minimise the amount WWF will continue to encourage visitors to bring their own reusable water bottles and food containers.

6.7.11 No waste receptacles are provided within MPNR and visitors will be encouraged to take their waste home with them. As such there will be no general waste deposited within MPNR during operation. Outside the Project Site, recycling bins will be provided for visitors before and after their visit to the MPNR.

Overall

6.7.12 ***Table 6-3*** summarises the generation of waste during the construction stage and identifies the appropriate management options for treatment and disposal of each waste type. Of the 280.3 tonnes of waste generated it is anticipated that up to 261.3 tonnes could potentially be treated /recycled/recovered, which is a 93% waste diversion rate from landfill.

Table 6-3 Summary of Waste Generation During Construction and Management Options

WASTE TYPE	ESTIMATED WASTE GENERATION DURING CONSTRUCTION		MANAGEMENT OPTIONS					
			REUSE/RECYCLE			DISPOSAL		
	TOTAL TONNES	TONNES/ MONTH*	APPROACH	TOTAL TONNES	TONNES/ MONTH*	APPROACH	TOTAL TONNES	TONNES/ MONTH*
Inert C&D Material	96.0	32.0	PFRF at Tuen Mun Area 38	96.0	32.0	N/A	0.0	0.0
C&D Waste (non-inert)	13.1	4.4	Segregation + off-site recycling	3.8	1.3	Disposal at NENT Landfill	9.3	3.1
C&D Waste (vegetation)	157.6	52.5	Composting within MPNR	157.6	52.5	N/A	0.0	0.0
General Refuse from Workers	13.6	4.5	Segregation + off-site recycling	3.9	1.3	Residual to NWNT RTS > Landfill	9.7	3.2
Chemical Waste#	0.0	0.0	N/A	0.0	0.0	N/A	0.0	0.0
Total	**280.3**	**93.4**		**261.3**	**87.1**		**19.0**	**6.3**

Note: *Based on a 3 months construction period from mid-April to mid-May 2022 and early-September to mid-October 2022.
No maintenance or repair of vehicles, plant or equipment will be allowed onsite and therefore no chemical waste will be generated during the construction phase of the Project.

6.7.13 Overall, provided that the recommended mitigation measures are followed, there should be no adverse waste impact from the handling, transportation or disposal of inert C&D material, C&D waste or general waste during construction.

6.7.14 During operation, there will be no waste of any type generated within the Project Site. No waste receptacles are provided within MPNR and visitors will be encouraged to take their waste home with them.

6.7.15 Finally, the works contractor is recommended to source any G200 rockfill that may be needed for the construction works from CEDD’s crushing plant at Tseung Kwan O Area 137, i.e. use G200 recycled rockfill if permitted in the design specifications.

7 ECOLOGICAL IMPACT

7.1 Introduction

7.1.1 This chapter considers the ecological impact of the Project Elements on the Project Site and on areas within 500m of the Project Site, as shown in ***Figure 7-1***.

7.1.2 The Project Elements and the Project Site are within MPNR, which is an area of brackish coastal wetland set up and managed for more than 30 years by WWF. MPNR itself and its surrounding wetlands (collectively referred to as the Inner Deep Bay area) is designated as a wetland of International Importance under the Ramsar Convention (i.e. Ramsar Site), an Important Bird Area by Birdlife International, a Flyway Network Site by the Partnership for the East Asian-Australasian Flyway and is identified as one of 16 critical inter-tidal areas in Asia for migratory waterbirds by the International Union for the Conservation of Nature (WWF 2013). The MPNR and Lut Chau to its south comprise the Mai Po Marshes Site of Special Scientific Interest (SSSI).

7.2 Relevant Legislation and Guidelines

General

7.2.1 Relevant legislation and associated guidelines related to ecological assessment include:

- Hong Kong Planning Standards and Guidelines (HKPSG) Chapter 10 "Conservation”
- *Town Planning Ordinance* (Cap. 131) and *Environmental Impact Assessment Ordinance* (Cap. 499) and subsidiary legislation and guidelines
- *Forests and Countryside Ordinance* (Cap. 96) and its subsidiary legislation, the Forestry Regulation (Cap. 96A)
- *Wild Animals Protection Ordinance* (Cap. 170)
- *Protection of Endangered Species of Animals and Plants Ordinance* (Cap. 586) and its subsidiary legislation

7.2.2 Specific legislation and guidelines relating to the EIA Process includes:

- Technical Memorandum for the Environmental Impact Assessment Ordinance (Cap 499) (EIAO-TM), particularly Annexes 8 (Criteria for Evaluating Ecological Impact) and 16 (Guidelines for Ecological Assessment)
- EIAO Guidance Note No. 6/2010 – Some Observations on Ecological Assessment from the Environmental Impact Assessment Ordinance Perspective
- EIAO Guidance Note No. 7/2010 – Ecological Baseline Survey for Ecological Assessment
- EIAO Guidance Note No. 10/2010 – Methodologies for Terrestrial and Freshwater Ecological Baseline Surveys

7.2.3 International conventions and guidelines that are relevant to this study include:

- **International Union for Conservation of Nature (IUCN).** The IUCN maintains, through its Species Survival Commission, a “Red List” of globally threatened species of wild plants and animals (see www.iucnredlist.org/).
- **United Nations Convention on Biological Diversity (CBD).** This requires parties to regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use. It also requires parties to promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings. The People’s Republic of China ratified the Convention on Biological Diversity on 5th January 1993. The convention came into force in Hong Kong during 2011. In the CBD Strategic Plan for Biodiversity 2011-2020, the Aichi Biodiversity Target 1 calls for people’s awareness of the value of biodiversity and the steps they can take to conserve and use it sustainably by 2020, at the latest.

- **Convention on Wetlands of International Importance (Ramsar Convention).** This relates to the protection and wise use of wetland ecosystems for the protection of biological diversity and sustainable development. The Convention requires signatories to designate at least one wetland site for inclusion in a list of Wetlands of International Importance (Ramsar sites); Mai Po Inner Deep Bay Ramsar Site is designated under this convention and supports internationally important numbers of several bird species.

Guidelines for Developments in the Deep Bay Area

7.2.4 *Town Planning Board Guideline No. 12C* (TPB PG-No.12C, revised in May 2014) sets out the Wetland Conservation Area (WCA) and Wetland Buffer Area (WBA) in the Deep Bay area to protect the wetlands of high ecological value in and around the Ramsar Site. Under the Guideline, any development is required to demonstrate conformity to the "No-Net-Loss in Wetland" principle. According to the guideline, the 'no-net-loss' can refer to both loss in "area" and "function". No decline in wetland or ecological functions served by the existing fishponds', especially as a source to provide abundant and accessible food and roosting grounds to ardeids and other species, should occur. Consideration will only be given to developments that can be demonstrated not to cause any loss in the ecological functions of existing ponds, whether arising from direct loss or adverse disturbance impact.

7.3 Ecological Baseline and Literature Review

Sites of Conservation Importance in the Area

Mai Po Nature Reserve

7.3.1 MPNR was set up in 1983 and is managed by WWF with support from Government. The overall responsibility for the Reserve lies with AFCD. It contains microhabitats such as dwarf mangroves, gei wai and rain-fed ponds, that provide important roosting and foraging sites for many waterbirds, including internationally important species such as the globally threatened Black-faced Spoonbill. All the Project elements covered by this EIA are within MPNR.

Mai Po Inner Deep Bay Ramsar Site

7.3.2 Mai Po Inner Deep Bay Ramsar Site was designated by the Government in 1995, under the "Convention on Wetlands of International Importance especially as Waterfowl Habitat" (the Ramsar Convention). The Mai Po Inner Deep Bay Ramsar Site covers an area of about 1,500ha and includes an area of intertidal mudflats and mangroves in Deep Bay as well as MPNR and some of the nearby fishponds. The mangroves and fishponds at Lut Chau are also included within the Ramsar Site.

7.3.3 Management of the Mai Po Inner Deep Bay Ramsar Site is determined by a management plan maintained by AFCD[Ref.#8], known as the *Mai Po Inner Deep Bay Ramsar Site Management Plan 2011*. Under this plan, the Ramsar Site is divided into several zones, determining the management actions for the area. MPNR, where the Project elements are located, is within the Biodiversity Management Zone (BMZ), the intention of which is to provide a refuge for waterfowl (including a high tide roost) with a focus on biodiversity conservation, education and training in a relatively intensively managed environment. Activities such as construction of visitor facilities and other infrastructure require management approval under the management plan.

Mai Po Marshes SSSI

7.3.4 Mai Po Marshes SSSI was designated in 1976 in recognition of the ecological importance of the mangrove communities and gei wai, and the importance of the site for ducks, shore and marsh birds. The SSSI site includes the MPNR and the fishpond area at Lut Chau.

8. https://www.afcd.gov.hk/english/conservation/con_wet/con_wet_look/con_wet_look_man/con_wet_look_man.html

Inner Deep Bay SSSI

7.3.5 Inner Deep Bay SSSI was designated in 1986. Inner Deep Bay SSSI contains the largest and most important dwarf mangrove communities in Hong Kong and an extensive natural intertidal mudflat of estuarine nature and a bay with shallow water. Both the dwarf mangroves and mudflat provide an important feeding and resting ground for waterbirds, especially during the wintering season. Much of the mangrove at Lut Chau lies within this SSSI. It borders MPNR, with the shortest distance from the Project elements being approximately 600m.

Wetland Conservation Area (WCA)

7.3.6 The Wetland Conservation Area (WCA) covers all existing contiguous and adjoining active/abandoned fishponds in the landward part of the Ramsar Site. It has a planning intention to conserve the ecological value of the fishponds, which form an integral part of the wetland ecosystem in the Deep Bay area. Mai Po NR and the Project Site lie on the seaward side of these fishponds, and part of the Project Site is immediately adjacent. Impacts arising from the Project Site would constitute impacts on the WCA, and description and mitigation of these is dealt with as part of the ecological impact assessment below.

Wetland Buffer Area (WBA)

7.3.7 The Wetland Buffer Area (WBA) is an approximately 500m wide strip of land along the landward side of the WCA designated to protect the ecological integrity of the fishponds and wetlands within the WCA, and to prevent developments that would have a negative off-site impact on the ecological value of fishponds. Impacts arising from the Project Site would constitute impacts on the WBA, and description and mitigation of these is dealt with as part of the ecological impact assessment below.

Priority Sites for Enhanced Conservation (PSEC)

7.3.8 Under the New Nature Conservation Policy, new proactive measures aimed at promoting conservation of several sites in collaboration with the private sector were established. These include Priority Sites for Enhanced Conservation (PSEC), the Management Agreement Scheme (MAS) and the Public-Private Partnership Scheme (PPPS). MPNR lies within the Ramsar Site PSEC, and near to the Wetland outside Ramsar Site PSEC. Impacts arising from the Project Site would constitute impacts on the Ramsar Site PSEC, and description and mitigation of these is dealt with as part of the ecological impact assessment below.

Egretries

7.3.9 Previous studies have found that breeding egrets in Hong Kong forage up to 4km from their egretry (Anon 1997), with most activity within approximately 1.5km. The Project Site is therefore within the foraging distance for egrets breeding at the following five existing and former egretries (as of 2020). It is unlikely that egrets from other egretries forage on site to a significant extent.

- Mai Po Marshes Nature Reserve egretry (first recorded in 2015, active in 2016 but moved to the mangrove area outside the Boundary Fence in 2017)
- Mai Po Mangrove egretry (active from 2017)
- Shan Pui River egretry (active from 2019)
- Mai Po Village egretry (active in 2020)
- Mai Po Lung Village egretry (active from 2000)
- Tam Kon Chau egretry (abandoned since 2009)

7.3.10 Established in 2015, Mai Po Marshes Nature Reserve egretry was in mangroves at gei wai 14, close to the Boundary Fence Road. It contained nests of Great Egret *Ardea alba*, Little Egret *Egretta garzetta*, Black-crowned Night Heron *Nycticorax nycticorax* and Eastern Cattle Egret *Bubulcus coromandus*. It was the second largest colony of the year in Hong Kong (204 nests, 14.4% of the total number of nests in Hong Kong (Anon. 2015a) and supported the highest number of nests of

Great Egret. However, in the following year, the total number of nests at this egretry decreased dramatically to 79 (61.3% decrease, Anon. 2016), although the trees where the ardeids nested appeared undisturbed. The breeding location within the Project Site was not occupied in 2017, again for unknown reasons as there was no apparent change in site conditions. Based on subsequent count data, it is assumed that the egretry has moved to the mangrove area outside the Boundary Fence. However, on a precautionary basis, it is assumed the site within the Project Site may be reoccupied in the future.

7.3.11 Shan Pui River Egretry was first noted in 2019 when it supported five nests of Little Egret and 86 of Chinese Pond Heron. In 2020 it grew to hold ten nests of Little Egret and 129 of Chinese Pond Heron. At its closest point it lies approximately 1.7km from the nearest Project Element (TH2).

7.3.12 Located close to the Shenzhen River channel, Mai Po Mangrove egretry is a very large colony that first established in 2017; in 2020 it supported 757 nests, of which 670 were those of Great Egret. It lies at least 2.4km from the nearest Project Element.

7.3.13 As of 2020 Mai Po Village egretry is marginally part of the Mai Po Village SSSI but its boundary has varied in recent years. In 2007, 34 nests were present, which increased to 236 nests in 2015 and 239 nests in 2017; however, this figure has since declined, and there were 113 nests in 2020. Little Egret and Chinese Pond Heron *Ardeola bacchus* have been the dominant species, with the latter usually most numerous; however, in 2019 and 2020 Little Egret was most numerous. Mai Po Village egretry is about 1.4km east of the MPNR boundary..

7.3.14 Mai Po Lung Village egretry held a total of 49 nests in 2007, but then declined in importance, presumably because birds moved to the Mai Po Village egretry (Anon. 2007, 2008, 2009, 2010 and 2011). However, the number of nests has risen in recent years to reach 160, the highest nest count at this egretry, in 2020. Chinese Pond Herons have always dominated at this site. Mai Po Lung Village egretry is about 2km east of the MPNR boundary.

7.3.15 Tam Kon Chau egretry used to be located on banyan trees next to the car park associated with the former Peter Scott Field Studies Centre (PSFSC). It supported 26 nests of Chinese Pond Heron in the 2007 breeding season and 23 nests of the same species in 2008, but has been abandoned since 2009, probably due to increased human activities underneath the trees, i.e. the presence of a container dwelling (Anon 2007, 2008, 2009).

7.3.16 ***Table 7-1*** summarises the numbers of nests of ardeids breeding at the above-mentioned egretries during 2007-2020 as reported by the Hong Kong Bird Watching Society[Ref.#9], while their locations are shown on ***Figure 7-1***.

Table 7-1 Numbers of Ardeid Nests at Egretries in MPNR and Surrounding Area, 2007 to 2020

YEAR	SPECIES	MPNR	MAI PO VILLAGE	MAI PO LUNG VILLAGE	TAM KON CHAU	SHAN PUI RIVER	MAI PO MANGROVE
2007	Little Egret	-	4	18	-	-	-
	Chinese Pond Heron	-	30	31	26	-	-
	Total	**-**	**34**	**49**	**26**	-	-
2008	Little Egret	-	2	16	-	-	-
	Chinese Pond Heron	-	55	21	23	-	-
	Total	**-**	**57**	**37**	**23**	-	-
2009	Little Egret	-	8	3	-	-	-
	Chinese Pond Heron	-	135	6	-	-	-
	Total	**-**	**143**	**9**	**-**	-	-

9. https://www.hkbws.org.hk/web/eng/egret_report_eng.htm

YEAR	SPECIES	MPNR	MAI PO VILLAGE	MAI PO LUNG VILLAGE	TAM KON CHAU	SHAN PUI RIVER	MAI PO MANGROVE
2010	Little Egret	-	19	2	-	-	-
	Chinese Pond Heron	-	109	5	-	-	-
	Total	**-**	**128**	**7**	**-**	-	-
2011	Little Egret	-	34	1	-	-	-
	Chinese Pond Heron	-	114	4	-	-	-
	Total	**-**	**148**	**5**	**-**	-	-
2012	Little Egret	-	29	-	-	-	-
	Chinese Pond Heron	-	125	12	-	-	-
	Total	**-**	**154**	**12**	**-**	-	-
2013	Little Egret	-	21	-	-	-	-
	Chinese Pond Heron	-	125	12	-	-	-
	Total	**-**	**146**	**12**	**-**	-	-
2014	Little Egret	-	80	3	-	-	-
	Chinese Pond Heron	-	122	33	-	-	-
	Total	**-**	**202**	**36**	**-**	-	-
2015	Great Egret	123	-	-	-	-	-
	Little Egret	10	104	5	-	-	-
	Black-crowned Night Heron	62	-	-	-	-	-
	Chinese Pond Heron	-	131	68	-	-	-
	Eastern Cattle Egret	9	1	-	-	-	-
	Total	**204**	**236**	**73**	**-**	-	-
2016	Great Egret	54	-	-	-	-	-
	Little Egret	11	72	16	-	-	-
	Black-crowned Night Heron	9	-	-	-	-	-
	Chinese Pond Heron	-	130	68	-	-	-
	Eastern Cattle Egret	5	-	-	-	-	-
	Total	**79**	**202**	**84**	**-**	-	-
2017	Little Egret	-	99	14	-	-	18
	Chinese Pond Heron	-	140	41	-	-	-
	Great Egret	-	-	-	-	-	26
	Night Heron	-	-	-	-	-	5
	Total	**-**	**239**	**55**	**-**	**-**	**49**
2018	Little Egret	-	99	14	-	-	21
	Chinese Pond Heron	-	123	53	-	-	-
	Great Egret	-	-	-	-	-	13
	Night Heron	-	-	-	-	-	4
	Eastern Cattle Egret	-	-	-	-	-	2
	Total	**-**	**222**	**67**	**-**	**-**	**40**

YEAR	SPECIES	MPNR	MAI PO VILLAGE	MAI PO LUNG VILLAGE	TAM KON CHAU	SHAN PUI RIVER	MAI PO MANGROVE
2019	Little Egret	-	91	41	-	5	5
	Chinese Pond Heron	-	68	68	-	86	
	Great Egret	-	-	-	-	-	6
	Eastern Cattle Egret	-	-	-	-	-	4
	Night Heron	-	-	-	-	-	2
	Unidentified	-	-	-	-	-	540
	Total	**-**	**159**	**109**	**-**	**91**	**557**
2020	Little Egret	-	70	34	-	10	4
	Chinese Pond Heron	-	43	126	-	129	
	Great Egret	-	-	-	-	-	670
	Cattle Egret	-	-	-	-	-	73
	Night Heron	-	-	-	-	-	10
	Total	**-**	**113**	**160**	**-**	**139**	**757**

Previous Ecological Surveys Conducted in the Assessment Area and its Vicinity

Long Term Monitoring at Mai Po Nature Reserve by WWF

7.3.17 Long-term, regular monitoring surveys have been conducted at MPNR for several years by WWF. Data from these surveys constitute a crucial part of the ecological baseline for the current submission. The following paragraphs review systematically the data of relevance collected in year 2015/16 or later (***Table 7-2***). In addition, Project-specific baseline ecological surveys were undertaken from November 2016 to December 2017; detailed survey methodology and findings are presented in ***Sections 7.4 and 7.5***, respectively.

7.3.18 Due to the time elapsed between survey completion in 2017 and the anticipated submission date of this report, data collected by WWF in the interim were also reviewed.

Table 7-2 List of WWF MPNR Ecological Baseline and Monitoring Data Reviewed Under the Current Study

FLORA/FAUNA GROUP	TIME AND FREQUENCY	PERIOD OF DATA FOR DETAILED REVIEW
Habitat Map	-	2015 and 2018[Note 1] versions
Flora	daytime	Aug - Oct 2016, May 2019 flora species list (***Appendix C1-1***)
Non-flying Mammals	cameras and traps working 24/7, data retrieved every 2 months	2019 species list (***Appendix C2-1***) 2016 and 2019 camera trap records
Bats	1 time/3 months	2019 species list (***Appendix C2-1***). Camera trap records since Sep 2015
Avifauna	morning (high tide if possible), 2 times/month, all year	2015 – 2019 (***Appendix C3-1, C3-4***)
Black-faced Spoonbill	noon, 2 times/month, Nov - Mar	2015 – 2019 (***Appendix C3-2***)
Roosting Anatidae	evening (high tide preferably), 2 times/month, late Oct - early Apr	2019-20 winter (***Appendix C3-3***)
Roosting Collared Crow	evening , twice/month, winter (mid-Dec to mid-Feb) and summer (Jul to Aug)	2019-20 winter and 2019 summer (***Table 7-6***)
Breeding Black-winged Stilt	Apr - Jun, min. 2 times/year	2007 - 2019 (***Table 7-7***)

FLORA/FAUNA GROUP	TIME AND FREQUENCY	PERIOD OF DATA FOR DETAILED REVIEW
Reptiles	not specific	2019 species list (***Appendix C4-1***) 2016 survey data (***Table 7-8***)
Amphibians	3 times in Apr, Jun and Aug	2019 species list (***Appendix C4-1***) 2016 survey data (***Appendix C4-2***)
Butterflies	1 time/2 months, wet season	2019 species list (***Appendix C5-1***) Survey data Apr - Oct 2016
Adult Odonates	monthly (am and pm), wet season	2019 species list (***Appendix C6-1***) Survey data Apr - Oct 2016
Four-spot Midget	Jun - Oct, 1 time/month	2019 odonate list (***Appendix C6-1***) Survey data Apr - Oct 2016 (***Table 7-10***)
Fireflies (two species)	Monthly, Apr – Sep	2018 & 2019 survey data (***Appendix C7-1***)
Aquatic Fauna Survey (fish and crustaceans)	1 time/3 months	Fish species list 2019 (***Appendix C8-1***) Survey data 2016 (***Appendix C8-2***)

Note:
1. Mai Po Nature Reserve Management Plan: 2019-2024. 2019. WWF-Hong Kong.

Habitat and Flora

7.3.19 Apart from small areas occupied by educational facilities, helipad and access roads etc., most of MPNR comprises wetland habitats, which can be broadly subdivided into brackish wetlands (gei wai) and rain-fed wetlands (ponds) (***Figure 7-2***). While the salinities of brackish habitats typically range from 2-3‰ (parts per thousand) in summer and 16-18‰ in late winter, those of rain-fed habitats also vary greatly between ponds with a range of 2-10‰ (WWF 2013); water bodies with salinities > 3ppt are generally considered to be brackish.

7.3.20 A flora survey commissioned by WWF was conducted within the MPNR and its vicinity between August and October 2016. A total of 187 plant species were recorded in the Reserve during the survey, of which three were species of conservation importance: Water Fern *Ceratopteris thalictroides*, Small Persimmon *Diospyros vaccinioides* and Hong Kong Pavetta *Pavetta hongkongensis* (***Figure 7-8***).

7.3.21 In the 2016 surveys, colonies of Water Fern were recorded near the southern edge of Pond 7, the rain-fed Pond 16, the northern edge of the reedbed in Pond 8b, and Pond 18. Water Fern is regarded as Rare by Xing *et al.* (2000) and considered as "Vulnerable" and under State Protection (Category II) in China.

7.3.22 Saplings of Small Persimmon were recorded next to the rain-shelter at gei wai 18, on the bund of Pond 16 and in the middle of the bund between Ponds 12 and 13. This species is classified as Critically Endangered (CR) on the IUCN Red List of Threatened Species. According to the IUCN Red List, the wild population of this species has been heavily exploited and collected as an ornamental species in Taiwan, leading to the complete absence of mature trees in the wild. However, it is regarded as a common to very common species in Hong Kong and is found in shrubland, thin forest and thickets in ravines or hillside habitats (Xing *et al*. 2000; AFCD 2007).

7.3.23 A single Hong Kong Pavetta was recorded in the middle of the bund between Ponds 12 and 13. Another three individuals were planted in the butterfly garden of Pond 15 for amenity reasons and to attract butterflies. Hong Kong Pavetta is commonly found in lowland forest, fung shui wood and thickets in Hong Kong (Xing *et al*. 2000, AFCD 2009), and is locally protected under Cap. 96A.

7.3.24 However, due to frequent management work in the form of vegetation-cutting and bund maintenance affecting the locations of some specimens, the locations of species of conservation importance shown on ***Figure 7-2*** are those from the more recent flora survey carried out by AEC in 2020. The results of this are summarised in ***paragraphs 7.5.9 to 7.5.11*** and ***Table 7-13***.

7.3.25 In addition, WWF updated its Mai Po Species list online in May 2019; this plant list containing all species previously recorded in MPNR is provided (as ***Appendix C1-1***). Apart from the above mentioned three species, *Zeuxine strateumatica*, a species in the family of Orchidaceae and therefore locally protected under Cap. 96A and Cap. 586, *Rhododendron simsii*, a Cap. 96A protected but locally common species, and *Ruppia maritima*, one of the five seagrass species in Hong Kong, are also on the list. *Zeuxine strateumatica* is regarded as Restricted in Xing *et al*. (2000), and 'Infrequent Widespread' in The Wild Orchids of Hong Kong (Barretto *et al*. 2011). This species in Hong Kong usually grows in full sun on disturbed, open, grassy areas and in low rolling country. The exact locations of *Zeuxine strateumatica* and *Rhododendron simsii* are not published. With regard to *Ruppia maritima*, it was observed in gei wai 3, 6, 7, 10 & 11 in 2015; however, during the vegetation surveys in 2016 and 2017 conducted by WWF, it was not found. This seagrass species has a very restricted distribution in Hong Kong. It was first recorded in Mai Po, and thus far has only been recorded in one other site, in Sai Kung.

Mammals

7.3.26 All the mammal species (including bats) that have been recorded in MPNR by WWF are presented in ***Appendix C2-1***, which is also available on WWF's website[Ref.#10].

Non-flying Mammals

7.3.27 Infra-red cameras and small mammal traps have been installed to monitor presence of non-flying mammals in the Reserve and in nearby areas such as the commercial fishponds and mangrove stands outside the Boundary Fence. In 2016, eleven mammal species, plus some unidentified rats, were recorded by these devices (***Table 7-3***, see ***Appendix C2-2*** for gei wai/pond specific data). Of these, East Asian Porcupine *Hystrix brachyura*, Eurasian Otter *Lutra lutra*, Leopard Cat *Prionailurus bengalensis*, Small Asian Mongoose *Herpestes javanicus* and Small Indian Civet *Viverricula indica* are considered species of conservation importance in China, albeit the population of Small Asian Mongoose in Hong Kong is of uncertain origin and may not be of natural origin.

Table 7-3 Non-flying Mammal Species Recorded Within the Project Site and Assessment Area in 2016 and 2019 by WWF Camera Traps and in 2016 by Small Mammal Traps

SPECIES NAME	FELLOWES *ET AL*	IUCN	CAP. 170	CAP. 586	AFCD ASSESSMENT	RED LIST OF CHINA'S VERTEBRATES (2016)	NO. RECORDS	
							WITHIN PROJECT SITE	WITHIN 500m Assessment Area
CAUGHT BY INFRA-RED CAMERAS								
Eurasian Otter *Lutra*	RC	NT	Y	Y	Rare; Species of Conservation Concern	EN	18	0
Leopard Cat *Prionailurus bengalensis*	-	LC	Y	Y	Uncommon	VU	84	82
Small Asian Mongoose *Herpestes javanicus*	-	LC	Y	Y	Uncommon	VU	7	1
Small Indian Civet *Viverricula indica*	-	LC	Y	Y	Very Common	VU	168	7
East Asian Porcupine *Hystrix brachyura*	PGC	LC	Y	-	Very Common	LC	1	0
Unidentified Rat	-	-	-	-	-	-	30	13
Wild Boar Sus *scrofa*	-	-	-	-	Very common	-	2	0

10. https://www.wwf.org.hk/en/reslib/programme_resources/water_wetlands/?16241/res-Mai-Po-Species-List

SPECIES NAME	FELLOWES *ET AL*	IUCN	CAP. 170	CAP. 586	AFCD ASSESSMENT	RED LIST OF CHINA'S VERTEBRATES (2016)	NO. RECORDS	
							WITHIN PROJECT SITE	WITHIN 500m Assessment Area
Rhesus Macaque *Macaca mulatta*	-	LC	Y	Y	Common	-	1	0
Pallas's Squirrel *Callosciurus erythrateus*			Y		Common	-	1	0
Domestic Cat *Felis catus*	-	-	-	-	Uncommon	-	34	3
Domestic Dog *Canis lupus familiaris*	-	-	-	-	Common	-	637	0
CAUGHT BY SMALL MAMMAL TRAPS								
Musk Shrew *Suncus murinus*	-	LC	-	-	Common	LC	1	0
Ryukyu Mouse *Mus caroli*	-	LC	-	-	Rare	LC	3	0
Lesser Rice-field Rat *Rattus losea*	-	LC	-	-	Recorded in Mai Po area	-	21	0
Asian House Rat *Rattus tanezumi*	-	LC	-	-	Common	LC	3	1
Unidentified Rat	-	-	-	-	-	-	4	0

Notes:

i. Fellowes et al. (2002). Wild animals to watch: Terrestrial and freshwater fauna of conservation concern in Hong Kong. Memoirs of the Hong Kong Natural History Society 25:123-159. : PGC = Potential Global Concern; RC = Regional Concern;
ii. IUCN Red List of Threatened Species. (available online at http://www.iucnredlist.org): LC = Least Concern; NT = Near Threatened;
iii. AFCD Assessment: Hong Kong Biodiversity Database. Accessed from https://www.afcd.gov.hk/english/conservation/hkbiodiversity/database/search.php in Feb 2017.
iv. Red List of China's Vertebrates (2016). Red List of China's Vertebrates. Biodiversity Science: 24 (5) 500-551.: LC = Least Concern; VU = Vulnerable; EN = Endangered.

7.3.28 In 2019, eight mammal species, plus an unidentified rat, were recorded by these devices (for detailed results see ***Appendix C2-2***). Of these, Eurasian Otter *Lutra*, Leopard Cat, and Small Indian Civet are considered species of conservation importance in China.

7.3.29 Eurasian Otter is a species of Regional Conservation significance (Fellowes *et al.* 2002), is listed as "Near-threatened" in IUCN Red List (www.iucnredlist.org) and as "Endangered" in the Red List of China's Vertebrates (Jiang *et al*. 2016). Locally it is protected under both Cap. 170 and Cap. 586, and AFCD considers it as Rare and a Species of Conservation Concern (AFCD 2017). Its distribution in Hong Kong appears to be confined to the northwest New Territories. Due to its sensitivity to disturbance, the potential impact of the proposed works will be assessed on a precautionary basis by assuming that it is present throughout the MPNR area.

7.3.30 According to the Mai Po Nature Reserve Management Plan: 2019-24[11], evidence of otters has been recorded in both fresh water and brackish ponds; historically there are records of otters in the following ponds/gei wai: 8, 10, 11, 15c, 16b, 22 and 24. Although no evidence of an otter holt

11. https://www.wwf.org.hk/en/reslib/programme_resources/water_wetlands/?16260/res-Mai-Po-Nature-Reserve-Habitat-Management-Monitoring--Research-Plan

or natal den, either underground or the above-ground couch-like structures reported by McMillan *et al*. (2020), has been found in MPNR, camera trap photos of an adult with pups indicated breeding has occurred there. As an apex predator, Eurasian Otter may play an important role in maintaining the ecological structure of the wetland.

7.3.31 Leopard Cat was the non-flying mammal species most frequently recorded by infra-red cameras, followed by Small Indian Civet. Both species are listed as Vulnerable under the Red List of China's Vertebrates (Jiang et al. 2016) and are protected under Cap. 170 and Cap. 586. East Asian Porcupine, a species of Potential Global Concern and protected under Cap.170, was captured once by a camera in 2016.

7.3.32 Occurrence Index (OI) values were calculated for the four mammal species of conservation importance. The OI was calculated as the number of photographs taken of each species for every 100 days of camera-trapping activities. Multiple photographs of the same individual at the same time were counted as a single observation. OI values of the non-flying mammal species of conservation importance at each camera trap location are given in ***Table 7-4***, and shown on ***Figures 7-3a to 7-3c***.

Table 7-4 OI Values of Non-flying Mammal Species of Conservation Importance Recorded by Infra-Red Cameras Within the Project Site and Assessment Area in 2016/2019 by WWF

CAMERA TRAP (ON *FIGURES 7-3A AND 7-3B*)	CODE (ON *FIGURES 7-3A AND 7-3B*)	LEOPARD CAT	SMALL INDIAN CIVET	EAST ASIAN PORCUPINE	Eurasian Otter
PROJECT SITE					
EC Access track HR2 / pond 16B	Dirt track	6.67/0	0/0	0/0	0/1.37
Gate 107	Gate107	5.51/0.72	3.48/0	0.29/0	0/0
gei wai 11	GW11	*/0.98	*/0.98	*/0	*/0
gei wai 13/14#	Gw1314	0	0	0	0
gei wai 18	Gw18	1.69/2.94	3.37/9.56	0/0	0/0
gei wai 19#	Gw19	0	0	0	0
gei wai 19/23#	Gw1923	0.87	1.74	0	0
gei wai 22/23#	Gw2223	16.67	16.67	0	0
gei wai 22a	GW22a	*/2.82	*/1.13	*/0	*/0
gei wai 22b#	Gw22b	1.31	2.61	0	0
gei wai 7#	Gw7	2.00	0	0	0
gei wai 8b#	Gw8b	0.39	0	0	0
Helipad#	Helipad	2.35	0	0	0
Pond 15 b/c#	P15bc	3.03	1.52	0	0
Pond 15 c floating platform#	P15cp	0	0	0	9.68
Pond 20/21#	P2021	0.57	1.72	0	0.57
Pond 24a		*/0	*/26.09	*/0	*/0
Pond 24f	P24f	8.88/2.93	19.74/6.84	0/0	0/0
ASSESSMENT AREA					
Fixed boardwalk in intertidal mangroves	fixedbw	24.65/5.88	1.06/0	0/0	0/0
Shek Shan	Shekshan	6.00/2.87	4.00/0.96	0/0	0/0
Yeung's Fisheries ponds#	Mr_Yeung_Pond	60	0	0	0

Notes: * indicates no camera in 2016 | # indicates no camera in 2019

Bats

7.3.33 Dusk bat transect survey using a bat detector (Echo Meter Touch) was conducted every three months since September 2015. The survey transects covered most of MPNR and nearby areas at Lut Chau and Mai Po (***Figure 7-4***). While all bat species recorded in the Reserve are presented in ***Appendix C2-1***, the species detected by bat detector (mainly those using echolocation for foraging), their conservation status and their relative abundance are listed in ***Table 7-5***, below.

Table 7-5 Bat Species Recorded by WWF Bat Detector and Relative Abundance 2015-17

SPECIES NAME	FELLOWES *ET AL*	IUCN	RED LIST OF CHINA'S VERTEBRATES (2016)	AFCD ASSESSMENT	RELATIVE ABUNDANCE
Intermediate Horseshoe Bat *Rhinolophus affinis*	(LC)	LC	LC	Uncommon	+
Least Horseshoe Bat *Rhinolophus pusillus*	PRC (RC)	LC	LC	Uncommon	+
Horsfield's Myotis *Myotis horsfieldii*	PRC (RC)	LC	LC	Rare; Species of Conservation Concern	+
Chinese Noctule *Nyctalus plancyi*	PRC (RC)	LC	LC	Common	++
Japanese Pipistrelle *Pipistrellus abramus*	-	LC	LC	Very Common	+++
Least Pipistrelle *Pipistrellus tenuis*	-	LC	NT	Uncommon	+++
Chinese Pipistrelle *Hypsugo pulveratus*	(LC)	LC	NT	Rare; Species of Conservation Concern	++
Lesser Bamboo Bat *Tylonycteris pachypus*	(LC)	LC	LC	Very Common	++
Lesser Yellow Bat *Scotophilus kuhlii*	(LC)	LC	LC	Uncommon	++
Greater Bent-winged Bat *Miniopterus magnater*	PRC (RC)	LC	NT	Data Deficient	++
Lesser Bent-winged Bat *Miniopterus pusillus*	(LC)	LC	NT	Uncommon	+

Notes:

i. All bat species in Hong Kong are protected under Cap. 170.
ii. Fellowes et al. (2002). Wild animals to watch: Terrestrial and freshwater fauna of conservation concern in Hong Kong. Memoirs of the Hong Kong Natural History Society 25:123-159. : LC = Local Concern; PGC = Potential Global Concern; RC = Regional Concern;
iii. IUCN Red List of Threatened Species. (available online at http://www.iucnredlist.org): LC = Least Concern; NT = Near Threatened;
iv. Red List of China's Vertebrates (2016). Red List of China's Vertebrates. Biodiversity Science: 24 (5) 500-551.: LC = Least Concern; VU = Vulnerable; EN = Endangered.
v. AFCD Assessment: Hong Kong Biodiversity Database. Accessed from http://www.afcd.gov.hk/english/conservation/hkbiodiversity/database/search.asp?lang=en in Feb 2017.
vi. Key for abundance: + = Scarce, ++ = Occasional, +++ = Frequent.

7.3.34 AFCD installed several bat boxes in MPNR in 2008 and 2009; some of them are along the existing footpath or near MPEC (***Figure 7-4***). Japanese Pipistrelle has been the only species reported to utilize the bat boxes since their installation (Shek *et al.* 2012). In addition, AFCD has also conducted mist net surveys and bat acoustic surveys at Mai Po Marshes Restricted Area (MPMRA) since 2003-04, with a total of 13 species recorded; these species are also listed in ***Appendix C2-1***.

Morning Bird Count

7.3.35 For long-term tracking of bird populations in MPNR, WWF commenced systematic bird surveys in 2003. All birds seen and/or heard along a fixed transect, which basically follows the perimeter of the part of the Reserve inside the boundary fence, are recorded twice per month all year round, starting at sunrise.

7.3.36 Between 2015 and 2019, the total number of bird species recorded during these surveys was 191, with 103 of conservation importance. Observations of all bird species recorded in surveys during this period are listed in ***Appendix C3-1***.

Black-faced Spoonbill

7.3.37 Black-faced Spoonbill is an Endangered species listed under the IUCN Red List with a population currently estimated at 2250[12]. Deep Bay is a very important wintering site to the global population of the species.

7.3.38 At MPNR, the numbers of roosting Black-faced Spoonbills have been monitored over the last decade. The surveillance is conducted during the middle of the day and covers all the Reserve inside the boundary fence with a particular focus on gei wai 3, 4, 6 and 7, forming Biodiversity Management Zone 1 (BMZ 1), which has the management intention of adjusting environmental conditions to support higher numbers of Black-faced Spoonbills. Monitoring is conducted during the peak period for Black-faced Spoonbills from November to March every year, twice per month. The findings of the five winter periods 2014-15 to 2018-19 are summarised in ***Appendix C3-2***.

7.3.39 Maximum numbers of roosting Black-faced Spoonbills at MPNR have fluctuated between 115 individuals in 2018-19 and 295 individuals in 2014-15 winter. In the 2015-16 winter there was a maximum of 206 individuals of Black-faced Spoonbill roosting, which accounted for approximately 6% of its global population census in 2016 (3,356 birds, IUCN 2017). In winter 2020-21 the highest count was 132 birds, which constitutes 5.8% of the global population. In terms of spatial distribution, BMZ 1 (especially gei wai 3) constantly supported high numbers of roosting Black-faced Spoonbills, while other roost concentrations were recorded at gei wai 10-12, gei wai 16/17 and gei wai 21-23.

Roosting Anatidae

7.3.40 Anatidae (mostly ducks) are one of the most abundant waterbird groups to use MPNR as a wintering site or a stopover on their migration route.

7.3.41 A roosting anatidae survey is conducted during the main period of duck occurrence (i.e. Oct – Apr) every year. The survey transect encircles the perimeter of the MPNR, with a particular focus on ponds used by roosting anatids, especially BMZ 5 (i.e. Gei wai 16/17) and BMZ 7 (gei wai 11a, 21, 22a and 22b), both of which are managed as a secure high-tide roost for wintering waterfowl.

7.3.42 Based on the 2019-20 winter survey findings, the mean and maximum counts of anatid species in each pond/gei wai are summarised in ***Appendix C3-3***. High abundance of anatids occurred in three areas: Pond/gei wai 3-8, gei wai 16/17 and Pond/gei wai 20-22. This is largely in line with the management intention of BMZs, with a third area of concentration around BMZ 1.

Roosting Collared Crows

7.3.43 Collared Crow is listed as a globally Vulnerable species under the IUCN Red List (2017) and was considered as of Local Concern by Fellowes *et al.* (2002). Given the global importance of Deep Bay in supporting the second-largest Collared Crow population in the world (Leader *et al.* 2016), many of which roost in the intertidal mangroves adjacent to MPNR, the roosting population of this species has been monitored regularly since 2003 at pre-roosting locations within the Reserve. The monitoring is conducted during two peak periods for the species, i.e. July and August (summer)

12. http://datazone.birdlife.org/species/factsheet/black-faced-spoonbill-platalea-minor

and late December to early February (mid-winter). Findings from summer 2019 and winter 2019-20, which are presented in ***Table 7-6***, indicate a winter peak count of 85 individuals and a summer peak count 197 individuals. The known pre-roosting locations include the central islands in gei wai 16/17 and 21 and trees along Ponds/gei wai 14, 18-22 and the southern section of the FCA road.

Table 7-6 WWF Collared Crow Monitoring: Summer 2019 and Winter 2019-20

DATE	MAX COUNT	FINAL ROOSTING LOCATION	COUNT LOCATION
WET SEASON			
5 July	197	Pond 21	FCA Road & Pond 22 helipad
24 July	175	Pond 21	FCA Road & Pond 22 helipad
6 August	175	Pond 18/19 path	FCA Road & Pond 22 helipad, Pond 18/19 path
28 August	174	Ponds 19, 21	FCA Road & Pond 22 helipad, Pond 18/19 path
DRY SEASON			
18 December	85	Pond 19W/20a bund trees	Ponds 20a, 21 road and 22 helipad
8 January	49	Pond 19W/20a bund trees	Ponds 20a, 21 road and 22 helipad
16 January	54	FCA mangrove	Ponds 19, 20a, 21 road, 23a path, 22 helipad
18 December	85	Pond 19W/20a bund trees	Ponds 20a, 21 road and 22 helipad

Breeding Black-winged Stilt

7.3.44 Black-winged Stilts started to breed at MPNR in 2003, and then bred annually in MPNR until 2012 and again in 2015; no breeding individuals of the species were reported in 2016 (but the birds bred at Pond 2a (outside the Boundary Fence) in 2017, as indicated in data from the current Study). Since 2007, numbers of nests and juveniles of Black-winged Stilt have been surveyed at least two times between April and June every year at all potential nesting sites, in particular the shallow water gei wai and rain-fed ponds where nesting by the species has taken place in the past.

7.3.45 Yearly maximum counts of Black-winged Stilt nests from 2007 to 2019 (excluding 2013 and 2014 when no birds nested) are listed in ***Table 7-7***. After peaking at 53 in 2011, the number of nests declined to zero in 2016; however, nest numbers were 37 in 2018 and 32 in 2020.

Table 7-7 Maximum Counts of Black-winged Stilt Nests in MPNR, 2007-21 (Source WWF)

YEAR	POND/GEI WAI NO.											TOTAL
	6	7/8	8	10	11	15A	15B	17B	16/17	21	23	
2007	0	0	0	0	0	3	0	0	18	0	15	23
2008	0	0	0	0	0	5	1	0	8	0	0	14
2009	0	0	0	0	0	0	0	1	27	0	0	28
2010	0	0	0	0	0	0	0	0	9	1	0	9
2011	0	0	3	0	0	8	0	0	21	39	0	53
2012	0	0	0	0	0	0	0	0	26	6	0	27
2015	0	0	0	0	0	0	0	0	0	0	0	6
2016	0	0	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	3	0	0	0	0	3
2018	10	0	0	0	7	0	0	0	20	0	0	37
2019	0	0	0	0	0	0	0	0	17	0	0	17
2020	0	0	0	1	0	0	0	0	13	1	0	15
2021	4	20	0	0	0	0	0	0	8	0	0	32

Reptiles

7.3.46 Reptile monitoring is not routinely scheduled by WWF, however, reptiles observed during other surveys are noted. A list of all reptile species (23 in total) recorded in MPNR is presented in ***Appendix C4-1***, together with their conservation status.

7.3.47 ***Table 7-8*** lists the reptile species recorded in WWF surveys during 2015-16. Reptile data for subsequent years is not available.

Table 7-8 Reptile Species Recorded in MPNR 2015-16 (Source WWF)

COMMON NAME	SCIENTIFIC NAME	CONSERVATION AND PROTECTION STATUS[NOTE 1]
Red-eared Slider[Note 2]	*Trachemys scripta*	-
Malayan Box Turtle[Note 2]	*Cuora amboinensis*	IUCN(VU); Cap.586
Reeves' Turtle	*Mauremys reevesii*	GC; RLCV(EN); IUCN(EN); Cap.170; Cap.586
Chinese Soft-shelled Turtle	*Pelodiscus sinensis*	GC; RLCV(EN); IUCN(VU); Cap.170
Grass Lizard	*Takydromus sexlineatus*	-
Long-tailed Skink	*Eutropis longicaudata*	-
Chinese Skink[Note 3]	*Plestiodon chinensis*	-
Reeves' Smooth Skink	*Scincella reevesii*	-
Four-clawed Gecko	*Gehyra mutilata*	RLCV(VU)
Bowring's Gecko	*Hemidactylus bowringii*	-
Copperhead Racer	*Coelognathus radiatus*	PRC; RLCV(EN)
Taiwan Kukri Snake	*Oligodon formosanus*	RLCV(NT)
Indo-Chinese Rat Snake	*Ptyas korros*	PRC; RLCV(VU)
Common Rat Snake[Note 3]	*Ptyas mucosus*	PRC; RLCV(EN); Cap.586
Many-banded Krait	*Bungarus multicinctus*	PRC; RLCV(EN)
Chinese Cobra[Note 3]	*Naja atra*	PRC: RLCV(VU); IUCN(VU); Cap.58
King Cobra	*Ophiophagus hannah*	PRC: RLCV(EN); IUCN(VU); Cap.58
Mangrove Water Snake	*Myrrophis bennettii*	LC
Chinese Water Snake	*Myrrophis chinensis*	RLCV(VU)
Checkered Keelback[Note 3]	*Xenochrophis flavipunctatus*	-
Burmese Python[Note 3]	*Python bivittatus*	PRC; RLCV(CR); IUCN(VU); CSMPS(I); Cap.170; Cap.586
Common Blind Snake	*Indotyphlops braminus*	-

Notes:

1 Conservation status recommended in Fellowes *et al.* (2002) apply to all fauna groups: LC = Local Concern; GC = Global Concern; PRC = Potential Regional Concern; RC = Regional Concern. Letters in parentheses indicate that the assessment is on the basis of restrictedness in nesting and/or roosting sites rather than in general occurrence. Other codes used in the column of Conservation and protection status:
   i. RLCV - Red List of China's Vertebrates (2016). Red List of China's Vertebrates. Biodiversity Science: 24 (5) 500-551.: VU = Vulnerable; EN = Endangered; CR= Critically Endangered.
   ii. IUCN - IUCN (2015) The IUCN Red List of Threatened Species (Version 2014.3): VU = Vulnerable. Please note the “Least Concern” status is not denoted particularly in the table.
   iii. Cap. 170 - Chapter 170 Wild Animals Protection Ordinance.
   iv. Cap. 586 - Chapter 586 Protection of Endangered Species of Animals and Plants Ordinance.

2 Non-native species, hence not of conservation significance in a Hong Kong context.

3 In 2016, five reptile species were reported on an ad-hoc basis, of which four (i.e. Burmese Python, Common Rat Snake, Checkered Keelback, and Chinese Skink) were observed within the Reserve and one (Chinese Cobra) was on the boardwalk outside the Boundary Fence . Within the Reserve, Burmese Python was recorded around P16b, P24, and along the footpath; Common Rat Snake, Checkered Keelback and Chinese Skink were found near P15b, P15c and the Education Centre, respectively.

7.3.48 Burmese Python is listed as of Potential Regional Concern by Fellowes *et al*. (2002). It is listed as Critically Endangered in China by RLCV (2016) and as Vulnerable by IUCN (2017) but is widely distributed in Hong Kong. It was reported at several locations in the Reserve in 2016, including Pond 16b, Pond 24 and on the footpath east of Pond 8a. Common Rat Snake, which is common in a variety of open habitats in Hong Kong (Karsen *et al*. 1998), is of Potential Regional Concern (Fellowes *et al*. 2002) and listed as 'Endangered' in RLCV (2016). It was found at Pond 15b near to the Education Centre floating platform. Chinese Cobra is also of Potential Regional Concern (Fellowes *et al*. 2002). It is listed as Vulnerable by both RLCV (2016) and IUCN (2017), although is widespread throughout the territory. In 2016, it was seen on the northern fixed boardwalk among the mangrove outside the Boundary Fence, and this species has been recorded inside the boundary fence too.

Amphibians

7.3.49 Amphibians at MPNR are present in the rain-fed ponds. In 2016, amphibian surveys were conducted three times in every other month between April and August. ***Appendix C4-2*** lists the survey findings, while a list of all amphibian species ever recorded in MPNR is presented in ***Appendix C4-1***. Amphibian data after 2016 are not available.

7.3.50 A total of four amphibians were found during surveys, i.e. Brown Tree Frog, Chinese Bullfrog, Günther's Frog and Paddy Frog. Most species were present in low numbers, although Günther's Frog was moderately common. All species are considered common throughout Hong Kong except Chinese Bullfrog, which is listed as being of Potential Regional Concern by Fellowes *et al.* (2002) and listed as 'Endangered' in Jiang *et al.* (2016). One individual of Chinese Bullfrog was recorded in Pond 16a during a survey in June 2016.

Butterflies

7.3.51 All butterfly species recorded at MPNR are detailed in ***Appendix C5-1***. In 2016, butterfly surveys were conducted four times every other month from April to October (see ***Figure 7-6*** for survey transect). Data from subsequent years are not available. The diversity and abundance of butterflies recorded on surveys in 2016 were both low, with a total of 35 species found (***Appendix C5-2***), likely due to the habitat types present on site, which are not suitable for most butterflies and provide few potential food sources for adults or larvae.

7.3.52 Three species of conservation importance were recorded: Common Awl, Danaid Egg-fly and a *Catochrysops* species. Two individuals of Common Awl were seen in October 2016. While this species occurs in a range of habitats, from coastal areas to upland forests, it is of Local Concern according to Fellowes *et al*. (2002) and is considered very rare in Hong Kong (by AFCD 2017). A few Danaid Egg-flies were found in October 2016. This agricultural land and fishpond associated species is of Local Concern (Fellowes *et al*. 2002) and is considered locally uncommon (by AFCD 2017). In addition, a *Catochrysops* species (one individual) was recorded between gei wai 18 and gei wai 19 in October 2016. Currently two *Catochrysops* butterflies have been recorded in Hong Kong, i.e. *Catochrysops panormus* and *Catochrysops strabo*; both are very rare and considered as Species of Conservation Concern (by AFCD 2017).

Odonates (Dragonflies and Damselflies)

7.3.53 Over 40% of Hong Kong's odonate species have been recorded in MPNR and/or its close vicinity (WWF Hong Kong 2013; also see ***Appendix C6-1*** for all odonate species recorded in the Reserve). During 2006-16, WWF conducted long-term monitoring of adult odonates at the majority of rain-fed ponds in MPNR (i.e. Pond 16b, Pond 17b, Pond 20 and Pond 24; see ***Figure 7-5*** for the transect route for odonate surveys), and has utilised species abundance and diversity findings to inform habitat management decisions.

7.3.54 According to the survey findings for 2016, MPNR supports a moderately diverse dragonfly community, with 25 species recorded (***Appendix C6-2***). Among the surveyed ponds, Pond 16b had the highest number of recorded odonate species (18 species). Most species recorded are widespread in lowland wetlands in Hong Kong. The only dragonflies in Fellowes *et al.* (2002) were

Coastal Glider, Blue Sprite, Ruby Darter and Scarlet Basker, all of which were listed as being of Local Concern despite their being common in suitable habitats. Some species were present in high abundance during surveys, most notably Common Bluetail, the peak count of which was 400 individuals; this species is abundant in Hong Kong in almost all wetlands, in particular marshes, ponds and even brackish water.

7.3.55 Four-spot Midget *Mortonagrion hirosei* was not found in the gei wai or rain-fed ponds of the Reserve during the 2016 odonate survey, as its favoured habitat is largely absent. The most recent record of this species within the MPNR Project Site was in May 2010, when a single male was seen on emergent vegetation composed of *Phragmites* stems and mats of grasses on the edge of a deep water channel (Stanton and Allcock 2011). Outside the Boundary Fence, Four-spot Midget was regularly reported in the intertidal mangrove stands, adjoining extensive intertidal mudflats in Deep Bay, as shown in ***Table 7-9***.

Table 7-9 Maximum Count of Four-spot Midget in Mangroves Outside Boundary Fence, 2011-16 (Source WWF)

	2011	2012	2013	2014	2015	2016
Maximum Count	10	85	82	N/A	5	25

Mai Po Bent-winged Firefly

7.3.56 In May 2015, WWF launched a two-year project, *Discovering Biodiversity in Hong Kong Wetlands*, with survey data collected between May 2015 and December 2016. The findings of this project provided evidence of the importance of Deep Bay for some rare and/or endemic species, including Mai Po Bent-winged Firefly *Pteroptyx maipo*, a species endemic to Deep Bay and named in 2011 (Ballantyne *et al.* 2011), as shown in ***Table 7-10***. In September 2016, a peak count of 915 Mai Po Bent-winged Fireflies was logged in the environs of MPNR, of which 310 individuals were recorded at the tidal creek near gei wai 19, accounting for approximately 34% of the total.

Table 7-10 Number of Mai Po Bent-winged Firefly Recorded in the Environs of MPNR, 2015-16 (Source WWF)

DATE	POND/GEI WAI NO.*									TOTAL IN MPNR
	#18	#19	#24G,F	#24E	#24C	#24A	#23	#22B	#22A	
8-Aug-15	0	0	0	1	0	0	5	3	0	**9**
12-Sep-15	0	0	0	1	11	25	26	10	11	**84**
17-Oct-15	0	0	0	0	2	5	2	2	0	**11**
30-Apr-16	0	5	0	0	0	1	6	4	17	**33**
14-May-16	8	32	20	12	10	4	17	14	12	**129**
30-May-16	4	32	11	10	20	0	0	0	0	**77**
18-Jun-16	0	0	0	0	0	13	14	3	12	**42**
21-Aug-16	21	72	26	17	22	9	24	38	20	**249**
3-Sep-16	20	310	100	60	210	15	45	122	33	**915**
17-Sep-16	46	19	2	5	35	9	6	19	11	**152**
1-Oct-16	1	3	0	0	5	3	4	5	10	**31**
Max. No.	**46**	**310**	**100**	**60**	**210**	**25**	**45**	**122**	**33**	

Note: * All Mai Po Bent-winged Fireflies were recorded in the tidal creek, outside the boundary of MPNR. The pond/gei wai numbers are used to indicate sections of the creek, rather than actual habitat/site they were recorded in.

7.3.57 The most recent WWF firefly survey data available relates to 2018 and 2019, and these are presented in ***Appendix C7-1***. Surveys were carried out in the southern gei wai and along the boundary fence road. The two highest totals of Mai Po Bent-winged Firefly were 184 on 27 September 2018 and 148 on 19 May 2019, mostly from the managed area of the reserve inside the boundary fence; favoured ponds were numbers 19 and 24A, C, E, F and G.

Aquatic Fauna (Fish, Crabs and Shrimps)

7.3.58 Until 2016, to understand the composition of aquatic fauna in MPNR (in particular, fish, crabs and shrimps), traps were placed in several ponds and gei wai and examined quarterly. In addition, fishing nets are set in front of sluices when the gates were opened to drain the ponds and fish and crustaceans are flushed out. ***Appendix C8-2*** presents the maximum counts of fish, crab and shrimp species that were recorded in the ponds/gei wai surveyed in 2016, using the two methods.

7.3.59 Among the other fish recorded in 2016, there are some taxa which were not identified to species level and thus their conservation status is not defined. These include *Channa* spp., *Chelon* spp., *Scorpaenopsis* spp., eels, gobies and tilapias. When checked against the online list of all fish species recorded in MPNR (***Appendix C8-1***), the unidentified fish species are unlikely to be of conservation importance except for an eel recorded in gei wai 19; it is possible that this individual was a Japanese Eel *Anguilla japonica*, a species considered as Endangered by IUCN (2017) and Jiang *et al*. (2016). Some crabs and shrimps were not identified to species level.

Other Ecological Studies in the Assessment Area and its Vicinity

7.3.60 In addition to WWF's long-term monitoring work, several studies under the EIAO conducted surveys in areas which partially overlap with the current 500m Assessment Area. These are listed below; their survey findings were reviewed as part of the baseline:

- EIA-144/2008 Proposed Comprehensive Development at Wo Shang Wai (Mott Connell 2008)
- EIA-161/2008 Construction of a Secondary Boundary Fence and New Sections of Primary Boundary Fence and Boundary Patrol Road (Mott MacDonald 2009)
- EIA-169/2009 Hong Kong Section of Guangzhou-Shenzhen-Hong Kong Express Rail Link (AECOM 2009)
- DIR-139/2006 An Extension to the Existing Boardwalk and New Floating Mudflat Bird-watching Hide at Mai Po Nature Reserve for Education and Conservation Purposes (WWF 2006)

7.3.61 Flora and fauna surveys for the Wo Shang Wai EIA study (Mott Connell 2008) were conducted in 2005/06; the survey area covered a small part of the commercial fishpond area to the southeast of Tam Kon Chau. Species of conservation importance reported by the project were detailed to habitat-level, without locations marked on a map. Therefore, on a precautionary basis, all the species of conservation importance, which were found in the habitat types present in the overlapped area, are considered to have the potential to occur in the current Assessment Area.

7.3.62 The project site of the Boundary Fence EIA (Mott MacDonald 2009) was divided into four sections; Section 1 overlaps with the current Assessment Area in Tam Kon Chau and its surrounding area including a small part of MPNR in its northeast. Baseline data presented in this EIA is section specific only. In view of the dominance of fishpond and gei wai in Section 1, which is similar habitat to the current Assessment Area, all species of conservation importance reported in Section 1 of the Boundary Fence EIA are considered to have the potential to occur in the current Assessment Area.

7.3.63 The survey area for the Mai Po Ventilation Building of the XRL alignment (AECOM 2009) encroaches onto the eastern edge of the current Assessment Area. According to the published EIA report, two bird species of conservation importance were reported in the Assessment Area. Both of these, together with the other fauna species of conservation importance noted above or recorded previously in MPNR, are summarised in ***Appendix C3-1***. No flora species of conservation importance recorded in these studies fell within the Assessment Area.

7.3.64 To assess the potential ecological impacts arising from the extension of the boardwalk and construction of a new bird-watching hide on the intertidal mudflat of MPNR, a study primarily based on a review of the available literature, in particular the *Mai Po Nature Reserve Habitat Management Plan (2006)* was conducted. In addition, surveys were conducted along the proposed boardwalk alignments, and at the location of the bird-watching hide, between June and October in 2004 and 2005, including structure and composition of mangrove trees/saplings, species and

abundance of birds associated with the intertidal mangrove and creek, and benthic fauna. All the flora and benthic fauna recorded during the surveys were typical of the habitats (i.e. mangrove, mudflat and intertidal creek); and the recorded bird species are widespread in Hong Kong and of low conservation significance in a Hong Kong context.

7.4 Ecological Survey Methodology

General

7.4.1 It is considered that the data of WWF's long-term ecological monitoring programme form an important part of the baseline for this EcoIA. However, supplementary surveys between November 2016 and December 2017 were conducted to provide more project-specific data and collect ecological information concerning the area outside MPNR but within the 500m Assessment Area. These comprised surveys of habitats, flora, mammals (bat roosts), birds (including transect surveys of birds, surveys of roosting Great Cormorant, and surveys of flight lines of cormorants departing from the roost), herpetofauna (amphibians and reptiles), odonates (dragonflies and damselflies), butterflies and benthic fauna. Survey methodologies are presented in the following sections; survey periods and frequencies for all surveys are detailed in ***Table 7-11***, below, and transects and counting points are shown in ***Figure 7-7.***

7.4.2 In addition, due to the time elapsed since the supplementary surveys were completed, 'verification surveys' were carried out from September 2019 to August 2020 to verify that ecological conditions in MPNR and adjacent areas remained broadly similar, and that the analysis and conclusions based on the data previously collected remained valid. These comprised surveys of habitats, flora, mammals, birds, butterflies, dragonflies, fireflies, herpetofauna and benthic fauna.

7.4.3 Survey methodologies are presented below; survey periods and frequencies for all surveys are detailed in ***Table 7-11***, below, and transects and count points are shown in ***Figure 7-7.*** The transect route followed in 2019-20 broadly matched that carried out in the earlier period with the exception of the section alongside the channelised watercourse in Fairview Park, which was not surveyed as a site check indicated it remained of low ecological value. In addition, two sections were added: one from the footpath to the location of TH3 and the second along the bund between ponds 21 and 20b in order to better survey relevant ponds. To minimise disturbance, however, the latter transect stopped at that point.

7.4.4 According to Clause 3.4.8.2 of the EIA Study Brief (ESB-301/2017), for aquatic ecology, the assessment area shall be the same as that for Water Quality Impact Assessment, which is 500m from the boundary of the Project and the Deep Bay Water Control Zone (WCZ). Aquatic and wetland-dependent fauna (fish, crustaceans, waterbirds and dragonflies etc.) of the water courses and gei wai/ ponds in the vicinity of the Project were covered by literature review of WWF's long-term monitoring data and the Project-specific 12-month ecological survey on the landward side of the 500m Assessment Area; epifauna and benthic infauna surveys were carried out not only within gei wai of the MPNR but also intertidal mudflat/mangrove of Inner Deep Bay.

Habitats and Flora

7.4.5 An updated habitat map has been created for MPNR and its vicinity, including all habitats within 500m of the Project Site. The map was prepared based on the most recent aerial photos and reviewed literature, in particular WWF's detailed Habitat Distribution at the Mai Po Nature Reserve in 2018, which was included in Mai Po Nature Reserve Habitat Management, Monitoring and Research Plan 2013-2018 (Volume II). Then, to account for any recent changes in habitats, ground truthing of the Project Site and Assessment Area was undertaken in the dry and wet seasons in 2020. The habitats of the entire site and the surrounding 500m were mapped using the software ArcGIS 10.2 and the area of each habitat was calculated.

Table 7-11 Schedule of Ecological Surveys (November 2016 – December 2017, September 2019 – August 2020)

FLORA / FAUNA GROUP		FREQUENCY OF SUPPLEMENTARY SURVEYS																									
		2016		2017												2019				2020							
		N	D	J	F	M	A	M	J	J	A	S	O	N	D	S	O	N	D	J	F	M	A	M	J	J	A
		DRY					WET							DRY		WET		DRY					WET				
Habitat and Flora						1		1			1			1								1					1
Non-flying Mammals				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bats (Roosts)				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Birds	Transect survey			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cormorant roosts	1	1	1	1	1												1	1	1	1	1					
	Dry-season cormorant flight lines	1	1	1	1	1												1	1	1	1	1					
	Mai Po Marshes Nature Reserve egretry					4	4	4	4	4												1	1	1	1	1	1
Herpetofauna							1	1	1	1	1	1	1			1	1						1	1	1	1	1
Odonata (incl. Four-spot Midget)							1	1	1	1	1	1	1			1	1						1	1	1	1	1
Butterflies						1	1	1	1	1	1	1	1	1		1	1						1	1	1	1	1
Fireflies (Mai Po Bent-winged Firefly)																						1	1	1	1	1	1
Benthic Fauna*												1															1

Note: * A further dry season benthic survey was carried out in January 2021.

7.4.6 Flora surveys by direct observation to identify the plant species and their relative abundance in different habitat types within the Assessment Area were conducted in March, May, August and November 2017 and verification surveys were carried out in March and August 2020. Survey methodology for plant species followed the guidelines set out in the EIAO Guidance Note 10/2004. These verification surveys paid particular attention to the footprint of the project elements, and a separate plant list for these was created.

Bat Roosts

7.4.7 In view of the daytime nature of construction works, possible bat roost sites including trees (e.g. Chinese Fan Palms *Livistona chinensis* potentially used by Short-nosed Fruit Bats *Cynopterus sphinx*), man-made structures and AFCD's bat boxes within MPNR (Shek *et al*. 2012) were assessed to determine whether any bat roosts would be impacted by the proposed construction works. Checks on bat roosts within MPNR and its vicinity were conducted monthly from January 2017.

Non-flying mammals

7.4.8 Data for non-flying mammals have been collected continuously by WWF-HK as part of its camera-trapping activities. Given the difficulty of surveying mammals by direct observation in the field, it was considered appropriate to rely on these as the primary source of non-flying mammal data.

7.4.9 The verification surveys carried out during 2019-20 recorded mammals in tandem with other faunal and floral surveys.

Birds

Transect Survey (Outside MPNR)

7.4.10 To supplement the established, routine morning bird count conducted by WWF within MPNR and provide a comprehensive baseline dataset of bird utilisation of all habitats within the 500m Assessment Area, fixed transect survey outside MPNR but within the Assessment Area was carried out monthly in 2017. During the surveys, a transect was followed to permit observation of most ponds present within the site, as well as the adjacent tidal creeks (see ***Figure 7-7***). All bird species seen or heard were recorded; birds recorded in pond habitat were detailed to individual pond level (pond numbers provided in ***Figure 7-7***). Special attention was paid to wetland-dependent species and species of conservation importance.

7.4.11 Verification surveys to confirm that ecological conditions in respect of birds remained similar in MPNR and adjacent areas were carried out from September 2019 to August 2020. The survey transect route broadly followed that previously used, with the addition of close approach to the footprints of the two tower hides, TH2 and TH3. Vegetation growth prevented survey along the access track to TH2. to minimise disturbance to Pond 21 in particular, which supported moderate numbers of waterbirds during the period, the surveyor did not walk to its proposed footprint.

Great Cormorant Roosts

7.4.12 Evening surveys were conducted to investigate the number and distribution of Great Cormorants roosting at MPNR. Surveys were conducted once per month from November 2016 until March 2017, and again from November 2019 to March 2020. All surveys started approximately one hour before sunset to permit a count of all roosting sites before it became too dark to accurately count the number of birds, although care was taken to avoid underestimating numbers on days when birds were still arriving at the start of the count. During the 2017 surveys, all groups of trees providing suitable conditions for roosting cormorants were observed and the total number of birds seen in each group of trees was recorded. Simultaneous counts were also conducted at Nam Sang Wai and Lok Ma Chau to ascertain the relative importance of the three roost sites and estimate the total Deep Bay population of this species. During the 2020 verification surveys, counts of the number of cormorants roosting according to pond/gei wai were carried out.

Dry-season Great Cormorant Flight Lines

7.4.13 Most Great Cormorants roosting at MPNR were observed leaving the site during the day to forage at wetlands around the Deep Bay area and in Deep Bay itself (Carey *et al*. 2001). To confirm the direction these birds flew when departing the site, and thus to establish whether the proposed works may affect the departure of roosting cormorants, flight line surveys were conducted once per month from November 2016 to March 2017. These surveys involved observers positioned between the main MPNR roost areas (***Figure 7-7***), recording the approximate route taken by cormorants and the approximate number seen departing in each direction. Surveys started 30 minutes before sunrise and continued until one hour after sunrise.

7.4.14 The verification surveys carried out in winter 2019-20 were made from a position near the centre of pond 8 from where a single surveyor was able to observe flight lines to the intertidal areas of Deep Bay and those that might pass close to the location of the proposed TH 3.

Mai Po Marshes Nature Reserve Egretry

7.4.15 Mai Po Marshes Nature Reserve egretry was first occupied in 2015 and reoccupied in 2016 (Anon. 2015, 2016) and was the only egretry within the Reserve. To obtain the up-to-date status of this egretry such that potential impacts of the project could be assessed, checks were conducted during the breeding season between March and July 2017 to determine if there was any nesting activity; however nonewas observed. Further checks were made in the 2020 breeding season, but no nesting activity was observed.

Herpetofauna

7.4.16 Daytime herpetofauna (amphibian and reptile) surveys were conducted at MPNR and the Assessment Area. A transect was followed around the site during sunny weather (***Figure 7-7***), recording all species of herpetofauna seen or heard. Specific effort was given to microhabitats likely to provide suitable conditions for herpetofauna, such as underneath stones, logs or other objects lying on the ground.

7.4.17 Amphibians are most easily located by their breeding vocalisations, which are given most often during the evening, especially in the early wet season. To survey the amphibian community at the Project Site and Assessment Area, night-time herpetofauna surveys were conducted once per month. Surveys started shortly after dusk, and during the surveys all amphibian species heard calling were recorded and their abundance counted or estimated. Any reptiles seen during the surveys were also recorded. Both daytime and night-time surveys were carried out in April to October 2017, September to October 2019 and April to August 2020.

Odonates and Butterflies

7.4.18 Odonates (dragonflies and damselflies) and butterflies were surveyed monthly, within the Project Site and Assessment Area. During the surveys, a fixed transect was followed (***Figure 7-7***); all species of odonate or butterfly were recorded and their abundance counted or estimated. Particular effort was given to habitats that may support greater abundance of odonates, especially rain-fed ponds with emergent vegetation.

7.4.19 Brackish reedbeds, brackish marsh and mangroves in the Deep Bay area are known to provide habitat for Four-spot Midget. During the odonate surveys, specific attention was paid to the possible presence of this species on site; however, it was not found either in MPNR or elsewhere in the Assessment Area.

7.4.20 Surveys of dragonflies were carried out from April to October 2017, September to October 2019 and April to August 2020. Surveys of butterflies were carried out from March to November 2017, September to October 2019 and April to August 2020.

Fireflies

7.4.21 Bent-winged Firefly surveys were conducted once per month from March to August 2020 in areas of suitable habitat in the Assessment Area. Surveys started shortly after sunset and continued until 90 minutes after sunset when the fireflies are most active. All Bent-winged Fireflies observed were recorded and their locations were marked onto a map. Particular effort was given to mangrove areas as this firefly species is mangrove-dependent.

Benthic Fauna

Gei Wai – Within Project Site

7.4.22 The abundance and species of the main benthic fauna communities associated with the locations of the two bird-watching hides (TH2 at gei wai 20 and TH3 at gei wai 8) were assessed in September 2017, August 2020 and January 2021. An epifauna survey was undertaken, counting individuals (e.g. crab and mudskipper) in each gei wai potentially affected. All benthic epifauna were counted using binoculars from a 10m distance.

7.4.23 Benthic infauna associated with the sediment near the hide's footprint was determined by collecting core samples (8cm diameter x 20cm depth) at randomly selected locations in the concerned gei wai. Infauna was sieved using a 5-micron mesh pan and classified to family level.

Intertidal Mudflat/Mangrove – Wider Assessment Area

7.4.24 Appropriate intertidal/benthic surveys to cover the intertidal mudflat/mangrove habitats within the Assessment Area were also conducted along the floating boardwalk outside of the Boundary Fence in September 2017 and August 2020. It should be noted that the closest potential works to both mangrove habitats (c. 500m distance at closest point) and intertidal mudflats (c. 1250m distance at closest point) would be those for the erection of TH2 at gei wai 20. Intertidal open mudflat does not fall within the 500m Assessment Area for this Project.

7.4.25 An epifauna survey was undertaken, counting individuals (e.g. crabs and mudskippers) along a transect covering the first 100m of the boardwalk. All benthic epifauna were counted using binoculars from a 10m distance.

7.4.26 Benthic infauna associated with the sediment were determined by collecting core samples (8cm diameter x 20cm depth) from alongside the floating boardwalk at two points; directly outside the border fence and at a point c. 100m from the border fence. Core samples were collected by randomly selecting three locations along a 1m line perpendicular to the floating boardwalk. Infauna was sieved using a 5-micron mesh pan and classified to family level.

7.5 Results of Ecological Surveys

Habitat and Vegetation

7.5.1 A habitat map of the 500m Assessment Area and the Project Site is provided in ***Figure 7-8***. A total of nine habitat types were identified, of which two (i.e. rain-fed pond and brackish gei wai) are present in the Project Site only. ***Appendix C1-2*** provides the plant species recorded in each of these habitats during the 12-month survey period in 2017. Representative photos of each identified habitats are included in ***Appendix C11***. No plant species of conservation importance were recorded in areas outside the Project Site.

7.5.2 Most habitat types in Assessment Area are wetlands, which constitute 90.7% of the whole Assessment Area and 99.3% of the Project Site in terms of area. Apart from the developed area of Fairview Park, areas of non-wetland habitats, such as the wooded area at Tam Kon Chau and village houses along Tam Kon Chau Road, are small and fragmented. Most of the wetlands in the whole Assessment Area comprise commercialfishpond, both active and abandoned (27.8% of the total area), mangrove (21.0%), marsh (3.6%), natural watercourse (2.8%) and channelised watercourse (0.2%). Areas of habitats present are detailed in ***Table 7-12***, below.

Table 7-12 Area of Habitat Within the Project Site and Assessment Area

HABITAT	WHOLE ASSESSMENT AREA		PROJECT SITE		ASSESSMENT AREA EXCL PROJECT SITE	
	AREA (ha)	%	AREA (ha)	%	AREA (ha)	%
Brackish gei wai	161.67	26.80%	161.67	75.15%		
Rain-fed Pond	51.2	8.49%	51.2	23.80%		
Mangrove	126.88	21.03%	0.11	0.05%	126.77	32.66%
Commercial Fishpond	167.82	27.82%			167.82	43.24%
Brackish Marsh	21.66	3.59%	0.62	0.29%	21.04	5.42%
Natural Watercourse	17.02	2.82%			17.02	4.39%
Channelised Watercourse	1.01	0.17%			1.01	0.26%
Wetland Subtotal	**547.26**	**90.72%**	**213.6**	**99.29%**	**333.66**	**85.97%**
Wooded Area	0.89	0.15%			0.89	0.23%
Developed Area	55.07	9.13%	1.52	0.71%	53.55	13.80%
Total	**603.22**		**215.12**		**388.10**	

Note: Habitat areas are rounded to the nearest 0.1ha. and percentages to one decimal place.

Habitats within Project Site

Rain-fed Ponds

7.5.3 Rain-fed ponds are present in the southern and eastern portions of the Project Site, i.e. Ponds 8a, 9, 15a-c, 16a, 16b, 17a, 17b, 20, 23 and 24 (***Figure 7-8***). These ponds vary in water depth and contain microhabitats such as open water, stands of reeds, sedges waterlilies and small islands of trees, which are all managed with the aim of providing roosting and feeding sites for waterbirds including egrets, herons and ducks. These rain-fed ponds are also of particular importance to the Reserve's odonate and amphibian species.

7.5.4 The emergent vegetation dominant in rain-fed ponds includes grasses Panicum dichotomiflorum and Brachiaria mutica, and aquatic herbs Ipomoea aquatica and Alternanthera sessilis. Common trees such as Hibiscus tiliaceus, Celtis sinensis, Cerbera manghas, Casuarina equisetifolia and Macaranga tanarius var. tomentosa grow along the pond bunds. Pond 16 supports aquatic vegetation such as the floating plant Nymphaea spp., and other common wetland plants Bacopa monnieri, Schoenoplectus subulatus and Lepironia articulata.

7.5.5 Reedbeds of *Phragmites australis* occur in both freshwater ponds and brackish gei wai, and dominate Ponds 8b, 9, 11, the landward half of 14, 17a, 23 and 24. These reed marsh areas are important for a suite of wetland-dependent waterbirds, particularly passage migrants and wintering species, including Eurasian Bittern, Purple Heron and Manchurian Reed Warbler. They are used for breeding by Yellow Bittern. Open water pools and channels within the reeds may be used by ducks, Little Grebe and rallids such as Common Moorhen and White-breasted Waterhen. Eurasian Otter has been recorded in reedbeds elsewhere in the Deep Bay area (e.g. Lok Ma Chau Loop), and presumably occurs in this habitat in MPNR.

Brackish Gei Wai

7.5.6 Brackish gei wai within the Reserve are connected with the tidal water from Deep Bay through operational sluice gates. As is detailed in WWF's *MPNR Management Plan 2019-2024*, they are managed either to rear shrimps and fish following traditional practices (at gei wai 8b, 10 to 14, 18 and western portion of 19) or to provide habitat for roosting waterbirds through provision of shallow water areas (at gei wai 3, 4, 6, 7, 16/17, 21 and 22). In the shrimp rearing gei wai, water is periodically drained across the dry season under a conservation management scheme; as the water level drops in each gei wai, the fish and shrimps inside are trapped in shallow pools and thus become available to piscivorous waterbirds. Typically, each gei wai is drained for an approximately two-week period.

7.5.7 In terms of vegetation, large stands of mangroves dominated by mature *Kandelia obovata* and *Aegiceras corniculatum* are present in gei wai 12, 13, 14, 18 and the western portion of gei wai 19, while gei wai 3, 4, 6 and 7 contain scattered mangal vegetation including true mangrove and mangrove associates *Kandelia obovata*, *Aegiceras corniculatum*, *Acrostichum aureum* and *Acanthus ilicifolius*. The gei wai 8b, 10, 11b and 22 contain areas of *Phragmites australis* to varying extents. On the central islands of all these gei wai there are groups of trees such as *Melia azedarach*, *Ficus subpisocarpa* and *Macaranga tanarius* var. *tomentosa*. Additionally, although it is not desirable, the invasive exotic weed *Mikania micranthus* has established extensively on top of many of these trees as well as the mangrove trees. The gei wai 16/17 and 21 are largely devoid of internal vegetation, with the aim to provide open water and shallow islands for roosting shorebirds and ducks.

7.5.8 Bunds of varying height and width are present throughout the Reserve, between ponds and gei wai, constituting an indispensable part of the wetlands. Vegetated bunds are dominated by grasses such as *Panicum* spp. and a variety of tree/shrub species such as *Celtis sinensis*, *Melia azedarach*, *Ficus* spp., *Macaranga tanarius* var. *tomentosa* and *Sapium sebiferum*. Unvegetated bunds are typically found close to recent desilting works.

7.5.9 Dry and wet season plant verification surveys were carried out in March and late August to early September 2020. Plant species recorded were very similar to those recorded in in 2017. Habitats found within the Mai Po Nature Reserve have remained stable, and mainly consist of brackish *gei wai*, rain-fed pond, mangrove and natural watercourse. In terms of flora species of conservation importance, the survey findings of the current ecological survey within the Project Site are in line with those reviewed in ***Section 7.3*** (***Figure 7-8***).

7.5.10 A list of plant species recorded under accessible footprint and immediately adjacent areas of the Project Elements during verification surveys in 2020 is provided in ***Appendix C1-3***. It should be noted that a precautionary approach was taken in regard to deciding which individual plant species should be included; consequently, not all the plant species will be directly impacted.

7.5.11 Five plant species identified in the above surveys are noteworthy; these are listed in the table below. Of these, Water Fern *Ceratopteris thalictroides*, and the two shrubs *Diospyros vaccinioides* and *Pavetta hongkongensis* are of conservation importance due to their protection and regional conservation status. The wetland herb *Sphenoclea zeylanica* and seagrass *Ruppia maritima* were not reported in the plant survey in 2017. A fairly extensive patch of *Sphenoclea zeylanica* was in Pond #8b. According to the plant monitoring survey conducted by WWF in May 2020, the seagrass *Ruppia maritima* was present in Ponds #3, #4, #6, #7, #10-#12, #19 and #21.

Table 7-13 Noteworthy Plant Species Recorded in Verification Surveys in 2020

SCIENTIFIC NAME	ORIGIN	GROWTH FORM	STATUS IN HK	SOURCE
Ceratopteris thalictroides	Native	Herb	"Rare" in Xing *et al*. (2000), and "Vulnerable" in Threatened Species List of China's Higher Plant and Status in China, under State protection (Category II) in China (AFCD 2003)	AEC surveys 2017 & 2020
Diospyros vaccinioides	Native	Shrub	"Critically Endangered" on IUCN Red List and "Endangered" in Threatened Species List of China's Higher Plant; very common in Hong Kong	AEC surveys 2017 & 2020
Pavetta hongkongensis	Native	Shrub/Tree	Protected under Cap. 96A; Common in Hong Kong	AEC surveys 2017 & 2020
Ruppia maritima	Native	Herb	"Very Rare" in Xing et al. (2000); restricted distribution in Hong Kong	WWF survey
Sphenoclea zeylanica	Native	Herb	Regarded as "Rare" by Xing *et al.* (2002); restricted distribution in Hong Kong	AEC survey 2020

References:
AFCD. 2003. Rare and Precious Plants of Hong Kong. AFCD. 234pp.
Xing, F.W., Ng, S.C. & Chau, L.K.C. 2000. Gymnosperms and angiosperms of Hong Kong. Memoirs of the Hong Kong Natural History Society 23: 21-136.

Developed Area

7.5.12 Developed area in the Project Site comprises buildings/facilities associated with the management of the reserve, primarily the Education Centre. These are of negligible ecological significance.

Habitats within Assessment Area but Outside Project Site

Mangroves and Intertidal Mudflats

7.5.13 Apart from the mangrove stands to the west of Lut Chau, most mangrovein the Assessment Area occurs within the MPNR, outside the Boundary Fence. Due to strict controls on entry, the area suffers very little anthropogenic disturbance, and it is one of the largest mangrove communities in Hong Kong. True mangrove tree species *Kandelia obovata* and *Aegiceras corniculatum* dominate the canopy, on which climbers such as *Derris trifoliata* and sometimes *Paederia scandens* spread. In addition, although great efforts have been paid to remove invasive *Sonneratia* spp. and *Mikania micranthus*, these species remain present in the area, but in low abundance.

7.5.14 Areas of pure intertidal mudflat in the Assessment Area are small. This habitat is used by waterbirds, including both large species such as ardeids and smaller species such as rallids (e.g., Slaty-breasted Rail) foraging on the benthic community. The broader area of intertidal mudflat adjoining these this habitat in the Assessment Area is of critical importance for thousands of migratory waterbirds that pass through in large numbers on migration or spend the non-breeding season here.

7.5.15 It should be noted that the gei wai are not intertidal and are more prone to invasion by non-wetland plant species; together with the disconnection from intertidal mangrove areas, this may have implications for habitat quality.

Commercial Fishponds

7.5.16 Commercial fishponds in the Assessment Area are present both within (at Shek Shan) and outside the MPNR. The fishponds outside the MPNR include the extensive clusters at Lut Chau, Pak Hok Chau, Tam Kon Chau and the western area of Mai Po, comprising mostly active fishponds and a small number of abandoned fishponds.

7.5.17 Active fishponds are maintained with mostly open water and little emergent vegetation. They are occasionally drained to permit harvesting of fish or maintenance of ponds. The composition and structure of vegetation is typical of fishponds in the Deep Bay, with simple vegetation structure and low vegetative diversity dominated by grassy vegetation (such as *Brachiaria mutica* and *Panicum maximum*); planted fruit trees such as lychee *Litchi chinensis*, logan *Dimocarpus longan*, wampee *Clausena lansium* and jackfruit *Artocarpus heterophyllus* occur along some of the bunds surrounding the ponds. Scattered village houses and other temporary structures are often associated with this habitat.

7.5.18 Several ponds, in particular those to the south of Pak Hok Chau, have been abandoned for decades. These abandoned ponds have become progressively colonised by vegetation to varying extents, so that some retain open water while others have become overgrown with grasses, reeds *Phragmites australis* and/or reedmace *Typha angustifolia*. Some ponds are connected to nearby channels via sluices or damaged bunds, and as a result the water within these ponds is tidal. Bund vegetation around the abandoned ponds is mostly grassy, dominated by *Brachiaria mutica* and *Panicum maximum*. Some bunds support groups of trees such as *Macaranga tanarius* var. *tomentosa*, *Melia azedarach* and *Hibiscus tiliaceus*.

Brackish Marshes

7.5.19 Marsh areas link strongly with and form an integral part of the banks of the natural watercourses that run between Shek Shan and Mai Po as well as along the southeastern perimeter of the MPNR. As the watercourses are subject to tidal influence, the marsh habitat within the Assessment Area is brackish in nature. Marsh ferns including Mangrove Fern *Acrostichum aureum*

and Interrupted Tri-vein Fern *Cyclosorus interruptus* and aquatic/wetland species *Eichhornia crassipes*, *Brachiaria mutica* and *Ipomoea aquatica* are the most abundant plants. In addition, small patches of *Phragmites australis* are scattered throughout the marshy area. Due to their patchy occurrence, these reedbeds are not differentiated from the marsh or treated as a separate habitat in this study.

Natural and Channelised Watercourses

7.5.20 Several natural watercourses of varying sizes run through the Assessment Area, connecting different types of wetland habitats and providing drainage to the area. The most important watercourse is that which flows from Fairview Park around the southeast boundary of MPNR and then between the Reserve and Lut Chau, before joining the Kam Tin River in the extreme southeast of the Assessment Area. In addition, two smaller watercourses discharge into the Shenzhen River to the north of Tam Kon Chau. As there is no physical boundary between these streams and their neighbouring habitats, the vegetation composition of the riparian zone is similar to adjacent areas. Commonly recorded plants within this habitat include wetland herbs *Cyperus malaccensis*, *Brachiaria mutica* and *Ludwigia hyssopifolia*, mangal vegetation *Acrostichum aureum* and *Acanthus ilicifolius*, and occasionally some trees/shrubs such as *Morus alba*, *Melia azedarach* and *Musa* x *paradisiaca,* which also grow on pond bunds.

7.5.21 The only channelised watercourse in the Assessment Area is located in the Fairview Park residential estate. Its concrete surface excludes any colonisation by wetland species, with only a line of ornamental trees including *Hibiscus tiliaceus*, *Grevillea robusta* and *Acacia* spp. planted on its banks. Despite its downstream connection with the natural watercourse, the artificial features of the channel section severely limit its ecological value and potential.

Wooded Areas

7.5.22 Two woodland patches are present in the Assessment Area, one at Shek Shan within the MPNR but outside the Project Site, and the other on the knoll at Tam Kon Chau Police Post and its adjacent area, also outside the Project Site.

7.5.23 The wooded area at Shek Shan is relatively small and isolated. It is dominated by naturally regenerated native tree species such as *Ficus microcarpa*, *Ficus tinctoria* and *Ficus subpisocarpa* in the canopy and *Bridelia tomentosa* and *Aporusa dioica* on the understorey. The woodland at Tam Kon Chau receives comparatively greater human disturbance, which is indicated by the presence of household waste and construction materials scattered around the woodland understorey. Trees such as *Macaranga tanarius* var. *tomentosa*, *Microcos nervosa*, *Ficus elastica* and *Ficus microcarpa* are the dominant species, while some fruit trees including *Litchi chinensis* and *Syzygium jambos* were also found in this area.

Developed Areas

7.5.24 Developed areas within the Assessment Area refers to the residential area at Fairview Park and small groups of domestic dwellings and associated farm structures, together with some government, institutional and community facilities mainly along Tam Kon Chau Road. Vegetation of Developed Areas is dominated by ornamental trees such as *Lagerstroemia speciosa*, *Bauhinia* x *blakeana*, *Caryota maxima* and *Archontophoenix alexandrae* and fruit trees such as *Dimocarpus longan*, *Litchi chinensis*, *Mangifera indica* and *Averrhoa carambola*, indicative of the relatively high level of human influence on this habitat. Other plant species frequently recorded included ornamental and garden shrubs such as *Hibiscus rosa-sinensis*, *Catharanthus roseus*, *Osmanthus fragrans* and *Codiaeum variegatum*.

Bat Roosts

7.5.25 The bat boxes installed by AFCD and other potential roosting sites for bats were checked monthly in 2017. During the monthly roost check, two bat roosts were found within and in close vicinity of MPNR; one is a roost for Short-nosed Fruit Bat on Chinese Fan Palms adjacent to Pond 182, and the other was found in a crevice between the wall panels of the green hut to the north of MPEC

(***Figure 7-4***). The species using the latter was not identified; however, this hut was renovated, and there appears to be little opportunity for roosting at present. Both roosts consisted of adults and juveniles; therefore, it is very likely that these were maternity roosts. In addition, Japanese Pipistrelle was found roosting under the roof tiles of the first floor of the MPEC in May and July 2017 (one individual each time), but not subsequently. ***Table 7-14*** lists the maximum counts of bats at all these locations in 2017.

7.5.26 Verification surveys carried out in 2019-20 counted the number of Short-nosed Fruit Bats using Chinese Fan Palms adjacent to Pond 182. The number roosting varied between 3 bats in July 2020 and 18 in February 2020. The latter is similar to the peak count of 16 in 2017, and the difference is not considered significant in terms of this Project.

Table 7-14 Maximum Counts of Bats at Roosting Sites in the Project Site and Assessment Area 2017

LOCATION	SHORT-NOSED FRUIT BATS		JAPANESE PIPISTRELLE		UNIDENTIFIED	
	ADULT	JUVENILE	ADULT	JUVENILE	ADULT	JUVENILE
AFCD bat box (M102)*	-	-	-	-	4	-
AFCD bat box (M103a)*	-	-	-	-	-	-
AFCD bat box (M402w)*	-	-	-	-	7	-
AFCD bat box (M402g)*	-	-	-	-	2	-
AFCD bat box (M402b)*	-	-	-	-	5	-
AFCD bat box (M407w)*	-	-	-	-	11	-
AFCD bat box (M407g)*	-	-	-	-	6	2
AFCD bat box (M407b)*	-	-	-	-	3	-
AFCD bat box (M408w)*	-	-	-	-	3	-
AFCD bat box (M408g)*	-	-	-	-	3	-
AFCD bat box (M408b)*	-	-	-	-	7	-
AFCD bat box (M405s)*	-	-	-	-	5	-
AFCD bat box (M105a)*	-	-	-	-	-	-
Green hut to north of MPEC	-	-	-	-	8	3
Chinese Fan Palm at Pond 182	13	3	-	-	-	-
MPEC	-	-	1	-	-	-

Note:* According to Shek *et al*. (2012), Japanese Pipistrelle is the only species utilizing the bat boxes since installation.

Non-flying Mammals

7.5.27 Data collected by WWF Camera Trap surveys is presented and discussed in 7.3.26-31. Two non-flying mammal species were recorded during flora and fauna transects in 2019-20: Pallas's Squirrel *Callioscurus javanicus* and Small Asian Mongoose *Herpestes javanicus* (***Appendix C2-3***). Neither is considered of conservation importance.

Birds

Bird Species Within MPNR and the Assessment Area

7.5.28 Five years of WWF Morning Bird Count data in MPNR up to 2019 are provided in ***Appendix C3-1*** in the form of mean and maximum counts for each species on the Reserve. The mean and maximum counts of all avifauna species at each pond and gei wai in MPNR are presented in ***Appendix C3-4*** (2017) and ***Appendix C3-6*** (2019-20). For the remaining part of the Assessment Area outside MPNR, the mean and maximum counts in 2017 are presented in ***Appendix C3-5***, and those in 2019-20 are presented in ***Appendix C3-7***. The mean and maximum counts of Black-faced

Spoonbills at each pond/gei wai for the five winter periods from 2014-15 to 2018-19 are presented in ***Appendix C3-2***. The mean and maximum count of anatid species at each pond/gei wai in MPNR during winter 2019-20 are presented in ***Appendix C3-3***.

7.5.29 As there is a wealth of data regarding the internationally important MPNR, ***Appendix C10*** summarises the key elements by providing all species of conservation importance that have been recorded at MPNR in a single list that includes a total of 110 bird species. The importance of the reserve to birds locally, regionally and internationally is undisputed.

7.5.30 The maximum count of bird species of conservation importance and/or wetland-dependent species recorded during the various surveys referenced in this Study in the gei wai/pond mosaic of MPNR, the mangrove habitat of MPNR (outside the Boundary Fence) and the Assessment Area (excluding the Project Site), respectively are provided in ***Table 7-15***, below.

Table 7-15 Maximum Counts of Bird Species of Conservation Importance and/or Wetland-dependant Species within the Project Site and Assessment Area, 2017-2020

NAME[NOTE 1]	SCIENTIFIC NAME	CONSERVATION AND PROTECTION STATUS[NOTE 2]	MPNR GEI WAI AND PONDS[NOTE 3]	MPNR MANGROVES[NOTE 4]	ASSESSMENT AREA EXCL. MPNR[NOTE 4]
Tundra Bean Goose*	*Anser serrirostris*	-	3		
Greater White-fronted Goose*	*Anser albifrons*	CSMPS(II)	3		
Eurasian Wigeon*	*Anas penelope*	RC	222		
Mallard*	*Anas platyrhynchos*	RC	1		
Chinese Spot-billed Duck*	*Anas zonorhyncha*	-	7		
Northern Shoveler*	*Anas clypeata*	RC	756		10
Northern Pintail*	*Anas acuta*	RC	582		
Garganey*	*Anas querquedula*	-	15		
Eurasian Teal*	*Anas crecca*	RC	677		
Tufted Duck*	*Aythya fuligula*	LC	478		7
Little Grebe*	*Tachybaptus ruficollis*	LC	37		56
Eurasian Spoonbill*	*Platalea leucorodia*	LC RLCV(NT) CITES(II) CSMPS(II) Cap.586	2		1
Black-faced Spoonbill*	*Platalea minor*	PGC RLCV(EN) IUCN(EN) CSMPS(II)	203		94
Yellow Bittern*	*Ixobrychus sinensis*	(LC)	6		1
Cinnamon Bittern*	*Ixobrychus cinnamomeus*	LC	1		
Black-crowned Night Heron*	*Nycticorax*	(LC)	60	4	11
Striated Heron*	*Butorides striata*	(LC)	11		
Chinese Pond Heron*	*Ardeola bacchus*	PRC (RC)	48	3	52
Eastern Cattle Egret*	*Bubulcus coromandus*	(LC)	56		17
Grey Heron*	*Ardea cinerea*	PRC	174	1	28
Purple Heron*	*Ardea purpurea*	RC	6		1
Great Egret*	*Ardea alba*	PRC (RC)	308	5	183
Intermediate Egret*	*Egretta intermedia*	RC	7		8
Little Egret*	*Egretta garzetta*	PRC (RC)	640	4	211
Great Cormorant*	*Phalacrocorax carbo*	PRC	2246		130
Western Osprey*	*Pandion haliaetus*	RC RLCV(NT) CITES(II) CSMPS(II) Cap.586	2		

NAME[NOTE 1]	SCIENTIFIC NAME	CONSERVATION AND PROTECTION STATUS[NOTE 2]	MPNR GEI WAI AND PONDS[NOTE 3]	MPNR MANGROVES[NOTE 4]	ASSESSMENT AREA EXCL. MPNR[NOTE 4]
Greater Spotted Eagle	*Clanga*	GC RLCV(EN) IUCN(VU) CITES(II) CSMPS(II) Cap.586	2		
Eastern Imperial Eagle	*Aquila heliaca*	GC RLCV(EN) IUCN(VU) CITES(II) CSMPS(I) Cap.586	1		
Crested Goshawk	*Accipiter trivirgatus*	RLCV(NT) CITES(II) CSMPS(II) Cap.586	2		
Japanese Sparrowhawk	*Accipiter gularis*	CSMPS(II) CITES(II) Cap.586	1		
Eastern Marsh Harrier	*Circus spilonotus*	LC RLCV(NT) CITES(II) CSMPS(II) Cap.586	2		
Black Kite	*Milvus migrans*	(RC) CITES(II) CSMPS(II) Cap.586	19	8	2
Eastern Buzzard	*Buteo japonicus*	CSMPS(II) CITES(II) Cap.586	3	1	1
White-breasted Waterhen*	*Amaurornis phoenicurus*	-	31	6	5
Watercock*	*Gallicrex cinerea*	RC	2		
Common Moorhen*	*Gallinula chloropus*	-	22		5
Eurasian Coot*	*Fulica atra*	RC	9		
Siberian Crane*	*Grus leucogeranus*	RLCV(CR) IUCN(CR) CITES(I) CSMPS(I) Cap.586	1		
Black-winged Stilt*	*Himantopus himantopus*	RC	95		22
Pied avocet*	*Recurvirostra avosetta*	RC	1033		5
Grey-headed Lapwing*	*Vanellus cinereus*	LC	1		
Pacific Golden Plover*	*Pluvialis fulva*	LC	7		6
Grey Plover*	*Pluvialis squatarola*	RC	5		
Little Ringed Plover*	*Charadrius dubius*	(LC)	3		8
Kentish Plover*	*Charadrius alexandrinus*	RC	1		
Lesser Sand Plover*	*Charadrius mongolus*	LC	3		
Greater Sand Plover*	*Charadrius leschenaultii*	RC	31		
Greater Painted-snipe*	*Rostratula benghalensis*	LC	1		
Pheasant-tailed Jacana*	*Hydrophasianus chirurgus*	LC RLCV(NT)	1		
Pintail/Swinhoe's Snipe*	*Gallinago stenura/ Gallinago megala*	LC for Swinhoe's Snipe	1		
Common Snipe*	*Gallinago*	-	2		1
Asian Dowitcher*	*Limnodromus semipalmatus*	RC RLCV(NT) IUCN(NT)	4		
Black-tailed Godwit*	*Limosa*	RC IUCN(NT)	125		
Bar-tailed Godwit*	*Limosa lapponica*	LC RLCV(NT) IUCN(NT)	2		
Whimbrel*	*Numenius phaeopus*	LC	83		
Eurasian Curlew*	*Numenius arquata*	RC RLCV(NT) IUCN(NT)	100		
Far Eastern Curlew*	*Numenius madagascariensis*	LC RLCV(VU) IUCN(EN)	1		
Spotted Redshank*	*Tringa erythropus*	RC	7		
Common Redshank*	*Tringa totanus*	RC	432		3

NAME[NOTE 1]	SCIENTIFIC NAME	CONSERVATION AND PROTECTION STATUS[NOTE 2]	MPNR GEI WAI AND PONDS[NOTE 3]	MPNR MANGROVES[NOTE 4]	ASSESSMENT AREA EXCL. MPNR[NOTE 4]
Marsh Sandpiper*	*Tringa stagnatilis*	RC	705		3
Common Greenshank*	*Tringa nebularia*	RC	412		2
Green Sandpiper*	*Tringa ochropus*	-	6		1
Wood Sandpiper*	*Tringa glareola*	LC	17		7
Terek Sandpiper*	*Xenus cinereus*	RC	1		
Common Sandpiper*	*Actitis hypoleucos*	-	10		5
Red-necked Stint*	*Calidris ruficollis*	LC IUCN(NT)	51		70
Long-toed Stint*	*Calidris subminuta*	LC			2
Curlew Sandpiper*	*Calidris ferruginea*	RC IUCN(NT)	3		
Dunlin*	*Calidris alpina*	RC	9		
Black-headed Gull*	*Chroicocephalus ridibundus*	PRC	200		
Heuglin's Gull*	*Larus fuscus*	LC	1		
Caspian Tern*	*Hydroprogne caspia*	RC	3		
Whiskered Tern*	*Chlidonias hybrida*	-	41		8
White-winged Tern*	*Chlidonias leucopterus*	-	50		
Greater Coucal	*Centropus sinensis*	CSMPS(II)	25	2	4
Asian Barred Owlet	*Glaucidium cuculoides*	CITES(II) CSMPS(II) Cap.586	1		1
White-throated Kingfisher*	*Halcyon smyrnensis*	(LC)	6	1	2
Black-capped Kingfisher*	*Halcyon pileata*	(LC)		1	
Common Kingfisher*	*Alcedo atthis*	-	11		4
Pied Kingfisher*	*Ceryle rudis*	(LC)	8		5
Peregrine Falcon	*Falco peregrinus*	(LC) RLCV(NT) CITES(I) CSMPS(II) Cap.586	1		
Black-naped Oriole	*Oriolus chinensis*	LC			2
Collared Crow*	*Corvus torquatus*	LC RLCV(NT) IUCN(VU)	31	18	2
Chinese Penduline Tit	*Remiz consobrinus*	RC	5		
Oriental Reed Warbler*	*Acrocephalus orientalis*	-	7	2	2
Black-browed Reed Warbler*	*Acrocephalus bistrigiceps*	-	2	2	2
Zitting Cisticola	*Cisticola juncidis*	LC			1
Chinese Hwamei	*Garrulax canorus*	RLCV(NT) CITES(II) Cap.586	2		
Red-billed Starling	*Spodiopsar sericeus*	GC	236	10	390
White-cheeked Starling	*Spodiopsar cineraceus*	PRC	13		8
White-shouldered Starling	*Sturnia sinensis*	(LC)	12		33
Common Starling	*Sturnus vulgaris*	LC	2		2
Green-backed Flycatcher	*Ficedula elisae*	RLCV(NT)		1	
Red-throated Pipit	*Anthus cervinus*	LC			1
Chinese Grosbeak	*Eophona migratoria*	LC	4		6
Chestnut-eared Bunting	*Emberiza fucata*	LC	1		
Black Swan*	*Cygnus atratus*	-	1		

Notes:

1. * indicates wetland-dependent species,

2. Conservation and protection status refer to:
   - Fellowes et al. (2002) Wild animals to watch: Terrestrial and freshwater fauna of conservation concern in Hong Kong. Memoirs of the Hong Kong Natural History Society 25:123-159.: LC=Local Concern; PRC=Potential Regional Concern; RC=Regional. Letters in parentheses indicate that the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence.
   - IUCN (2017) The IUCN Red List of Threatened Species: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern.
   - Red List of China's Vertebrates (RLCV, 2016). Red List of China's Vertebrates. Biodiversity Science: 24 (5) 500-551.: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient.
   - Ministry of Environmental Protection of the People's Republic of China (2002) China State Major Protection Status: I = Class I Protected Species; II = Class II Protected Species.
   - Cap. 170 = Chapter 170 Wild Animals Protection Ordinance. All wild birds are protected under Cap. 170.
   - Cap. 586 = Chapter 586 Protection of Endangered Species of Animals and Plants Ordinance
3. Data of MPNR (gei wai and ponds) are generated from WWF's Morning Bird Count Data 2017
4. Data of MPNR (mangrove) and the Assessment Area generated from the 12-month ecological survey for the Project.

7.5.31 ***Appendix C3-4*** presents the bird species recorded on each gei wai/pond in 2017. A total of 146 bird species were recorded at MPNR during the year, of which 91 species (62%) are considered as of conservation importance and/or wetland dependent. The diversity of birds was highest at gei wai 21, while the lowest was at Pond 20e. In the gei wai with highest diversity, the most abundant waterbirds were Common Greenshank, Eurasian Wigeon and Grey Heron.

7.5.32 Across the whole Reserve, Great Cormorant, Great Egret, Pied Avocet, Northern Shoveler and Common Greenshank were the most abundant species; all of these are species of conservation importance.

7.5.33 ***Appendix C3-5*** presents the bird species recorded in 2017 in the Assessment Area outside the Project Site (MPNR) according to the habitat utilised, while ***Appendix C3-7*** presents the same data collected in 2019-20. Commercial fishponds supported the highest number of species and the highest abundance of birds. The importance of commercial fishponds to waterbirds in Hong Kong is well-established, and these data confirm that.

7.5.34 ***Appendix C3-6*** summarises the data collected in the verification surveys of 2019-2020. A total of 107 bird species were recorded at MPNR during the year, of which 68 (64%) are of conservation importance or wetland dependent. The number of species was highest at gei wai 16/17, while it was lowest at Pond 17a. In the gei wai with the highest diversity, the most abundant waterbirds were Northern Shoveler and Pied Avocet. It is not considered that the difference in the number of species recorded is significant in terms of this Project (i.e., the lower number of species does not indicate a decline in habitat quality).

Great Cormorant Roosting in MPNR

7.5.35 MPNR contains a large overnight roost of wintering Great Cormorants. Most leave the night roost during the early morning, but many remain throughout the day. Surveys of roosting cormorants were conducted monthly between November 2016 and March 2017 (***Table 7-16***). Surveys recorded both the number and the distribution of cormorants roosting at MPNR. Simultaneous counts were conducted at Nam Sang Wai and Lok Ma Chau.

Table 7-16 Winter Roost Counts of Great Cormorants at Mai Po Nature Reserve, Lok Ma Chau and Nam Sang Wai, November 2016 to March 2017

DATE	MPNR ROOST	LOK MA CHAU ROOST	NAM SANG WAI ROOST	OVERALL DEEP BAY TOTAL	%AGE OF DEEP BAY TOTAL IN MPNR
Nov-16	1,720	1,185	3,453	6,358	27%
Dec-16	2,530	1,570	3,688	7,788	32%
Jan-17	3,177	2,170	5,615	10,962	29%
Feb-17	2,431	1,396	3,967	7,794	31%
Mar-17	1,435	1,226	1,886	4,547	32%

7.5.36 Up to 10,962 Great Cormorants were recorded roosting in the Deep Bay area during the 2016-17 winter. The peak count at MPNR was 3,177 recorded in January 2017. The population trends for the Great Cormorants roosting at MPNR, Lok Ma Chau and Nam Sang Wai were the same among the three areas, with a progressive increase in numbers over the first half of the winter, a peak in January 2017, and then a decline over the second half of the winter.

7.5.37 The distribution of roosting Great Cormorants across the three areas did not change significantly during the survey period, with Nam Sang Wai the largest roost (accounting for 41-54% of the total roosting Great Cormorants), Lok Ma Chau the smallest (18-27%) and MPNR holding the remainder (27-32%) throughout the five roost counts.

7.5.38 At MPNR, there were two main areas for the roosting Great Cormorants in the 2016-17 winter (***Figure 7-9***). Most individuals roosted in groups of trees on the bunds of Ponds 15a - 15c and adjacent commercialfishponds, where up to 2,501 birds were recorded. Birds in this area roosted in a variety of tree species, including *Casuarina equisetifolia*, *Melia azederach* and *Albizia lebbeck*. In addition, cormorants roosted along the bunds of gei wai 10 and 11, mostly in *C. equisetifolia*, *M. azederach* and *Ficus subpisocarpa*; up to 658 birds were recorded roosting in this area. Although the Pond 15 roosting area always supported larger numbers of Great Cormorants, its percentage of the total decreased from 87% recorded in November 2016 to 66% in March 2017, while the percentage using the area of gei wai 10 and 11 increased from 13% to 34%. The change in the proportion of birds using different parts of the roost suggests individual birds may not use the same area within a roost site throughout the winter. Local research has found that cormorants may change major roost sites during the winter; a radio-telemetry study undertaken in 2011-12 (Ma 2014) showed that a single tracked individual was recorded roosting mostly at Nam Sang Wai but sometimes changed to roost at Mai Po.

7.5.39 On the same day of each monthly Great Cormorant roost count in the 2016-17 winter a survey was conducted in the morning to record the direction of departure of the birds leaving their MPNR night roost. The surveys from November 2016 to January 2017 showed that, despite the lack of any clearly defined flight lines, the majority of cormorants departed broadly towards the north and the east; most of them are likely to forage in the fishponds around Mai Po and in Deep Bay. However, during the surveys in February and March 2017, fewer than five individuals of Great Cormorant were observed leaving their night roost; almost all the birds stayed on the trees. The reason for the cormorants lingering on their roost rather than flying out for foraging in these surveys is unknown but may be weather-related.

7.5.40 Great Cormorant roost counts were also carried out as part of the verification surveys in winter 2019-20 at MPNR. The number of roosting birds in each monthly count is presented in ***Table 7-17***. Numbers were, thus, much lower than those recorded in the 2016-17 surveys, though the pattern of an increase to a January peak was the same. The establishment of a large cormorant roost at Lok Ma Chau appears to have caused a decline in the number of birds roosting at MPNR in recent years.

Table 7-17 Winter Roost Counts and Location of Great Cormorants at Mai Po Nature Reserve, November to March 2016-2017 and 2019-2020

DATE	ROOST TOTAL	Pond 10-8	Pond 10-11	Casuarinas at Pond 12	Pond 15A	Pond 15B	Pond 15C
Nov-16	1,720	19	208	12	70	781	630
Dec-16	2,530	131	422	30	137	660	1150
Jan-17	3,177	8	650	18	156	966	1379
Feb-17	2,431	35	458		875	1063	
Mar-17	1435	192	290		25	286	642
Nov-19	50			50			
Dec-19	310		210		63	37	37

DATE	ROOST TOTAL	Pond 10-8	Pond 10-11	Casuarinas at Pond 12	Pond 15A	Pond 15B	Pond 15C
Nov-16	1,720	19	208	12	70	781	630
Dec-16	2,530	131	422	30	137	660	1150
Jan-17	3,177	8	650	18	156	966	1379
Feb-17	2,431	35	458		875	1063	
Mar-17	1435	192	290		25	286	642
Jan-20	855		260		30	350	350
Feb-20	283		188		15	80	80
Mar-20	108		83	25			

7.5.41 In terms of distribution, excluding November, the highest number of birds were generally in trees along the bunds of ponds 10 and 11 or in trees around ponds 15A to 15C. Thus, although numbers were substantially lower than the 2016-17 winter, distribution was broadly similar, although no birds were recorded roosting above the bund between ponds 10 and 8.

7.5.42 A survey to record the direction of departure of birds leaving the roost was also conducted the morning after the evening roost count. In November the movement of birds from the MPNR roost was to the north, with other birds flying south across the reserve, both close to the line of Casuarina trees; there were, however, no well-defined flight lines. In December, there was no clear pattern of departure. In January to March there were two major flight lines, to the north toward commercial fishpond areas and to the west toward intertidal areas. The former is close to the footpath and over or very near the location of TH3. It is likely these birds originated at Nam Sang Wai given the location and orientation of this flight line. The location of these flight lines recorded is presented in ***Figure 7-11***.

Egretries and Ardeid Roosts

7.5.43 Checks to determine whether an egretry formed in MPNR egretry site were conducted from the beginning of the breeding season in March 2017 and March 2020, but no nesting activity was observed, and it can be concluded that the site was not used in either year. The former egretry at Tam Kon Chau was last used in 2008.

7.5.44 A new egretry in the mangrove area outside the Boundary Fence was active in 2017, 2018 and 2019 (***Table 7-1***). The approximate location of the egretry is at the northwest of the mangrove stand next to the Shenzhen River. The shortest distance of the egretry to all Project Elements is approximately 2.4 km. A second egretry at Shan Pui River was active from 2019; this lies at approximately 1.7km from the nearest Project Element.

7.5.45 An ardeid night roost occupies the group of large trees just north of the PSFSC site; the distance to the nearest project element is approximately 280 m. During surveys from April 2019 to April 2020 in relation to the demolition of the PSFSC, the number of birds utilising this roost ranged from 10 to 648, with highest counts occurring in the first four months of the year. Most birds flew to the roost site from the south-southeast (i.e. over the Tam Kon Chau fishponds, possibly from the Tai Sang Wai-Lut Chau-Nam Sang Wai area) in the 30 minutes around sunset (AEC unpub).

7.5.46 In addition, pre-roosts of ardeids near GW8a and 10, and a small winter night roost at GW15a have also been recorded (AFCD in litt.).

Herpetofauna

7.5.47 Herpetofauna diversity recorded in the Assessment Area is relatively low in general, and only 30 species have been recorded in MPNR (***Appendix C4-1***). Mean and maximum counts of amphibian species in each pond/gei wai in 2016 are presented in ***Appendix C4-2***; four species were recorded. A total of seven amphibian species and 13 reptile species were recorded during the 12-month survey in 2017; of these, six amphibian species and seven reptile species were recorded in the ponds and gei wai of the Project Site (***Appendix C4-3***).

7.5.48 The only amphibian species of conservation importance, as shown in ***Table 7-18***, below, was Chinese Bullfrog, which was recorded near the MPEC. Chinese Bullfrog is of Potential Regional Concern (Fellowes *et al.* 2002) and is listed as Endangered in China (Jiang *et al.* 2016); it is also a Class II protected species in Mainland China. It is, however, widespread in Hong Kong.

7.5.49 In terms of reptile species of conservation importance, a Burmese Python was recorded on the access road next to gei wai 22b in the southern part of MPNR. The shed skin of a Chinese Cobra was found on the access road outside the AFCD Mai Po Warden Post. Common Rat Snake was recorded along the bund of gei wai 23 and in the bat box M405s (***Figure 7-4***). Indo-Chinese Rat Snake and Many-banded Krait were found along Tam Kon Chau Road. The conservation and protection status of the five reptile species are summarised below. Locations where species of conservation importance were observed are shown on ***Figures 7-8a-e***.

7.5.50 Verification surveys carried out in 2019-20 recorded five species of amphibian and three species of reptile (***Appendix C4-4***). The only amphibian species of conservation importance was again Chinese Bullfrog, while the only reptile of conservation importance was Common Rat Snake.

Table 7-18 Herpetofauna Species of Conservation Importance Recorded in 2017 and 2019-20 Surveys

COMMON NAME	SCIENTIFIC NAME	CONSERVATION AND PROTECTION STATUS*
AMPHIBIANS		
Chinese Bullfrog	*Hoplobatrachus rugulosus*	PRC; RLCV(EN); CSMPS(II)
REPTILES		
Indo-Chinese Rat Snake	*Ptyas korros*	PRC; RLCV(VU)
Common Rat Snake	*Ptyas mucosus*	PRC; RLCV(EN); CITES(II); Cap.586
Many-banded Krait	*Bungarus multicinctus*	PRC; RLCV(EN)
Chinese Cobra	*Naja atra*	PRC: RLCV(VU); IUCN(VU); CITES(II); Cap.586
Burmese Python	*Python bivittatus*	PRC; RLCV(CR); IUCN(VU); CITES(II); CSMPS(I); Cap.170; Cap.586

Note: * Conservation and protection status refers to:

a. Conservation status by Fellowes et al. (2002): PRC = Potential Regional Concern.
b. Conservation status by Red List of China's Vertebrates (RLCV) (Jiang et al. 2016): CR = Critically Endangered; VU = Vulnerable.
c. Protection status by CITES (2017): II = Listed in CITES Appendix II.
d. China State Major Protection Status (CSMPS): I = Class I Protected Species in China.
e. Cap. 170 = Wild Animal Protection Ordinance
f. Cap. 586 = Protection of Endangered Species of Animals and Plants Ordinance.

Butterflies

7.5.51 The diversity and abundance of butterflies in the Assessment Area is relatively low (***Appendix C5-1***, ***C5-2***). In general, the habitat types present, which support a low diversity of native plant species and relatively low vegetative structural diversity, are not suitable for most butterflies, providing few potential sources of food for adults or larvae. The only species of conservation importance listed that was not recorded in surveys for this study is Danaid Egg-fly.

7.5.52 Four species of conservation importance were recorded in surveys carried out in 2017 and 2019-20 (***Appendix C5-3, C5-4***), namely Common Awl, Small Cabbage White, Forget-me-not and Grass Demon. Common Awl was recorded in mangrove area at the floating boardwalk and on edges of gei wai 16/17, while Small Cabbage White was recorded from edges of brackish gei wai, commercial fishpond and wooded area. Forget-me-not was seen in rain-fed pond and the wooded area near the former PSFSC, and Grass Demon was recorded at gei wai 14 (***Figures 7-8 a-e***). In Hong Kong, Common Awl and Small Cabbage White are considered Very Rare and Rare, respectively (by AFCD 2017), albeit Small Cabbage White is a globally invasive pest species Holland (1931). Forget-me-not and Grass Demon are both considered as Rare (by AFCD 2017). During the 2019-20 surveys, the only species of conservation importance recorded was Common Awl.

Odonates (Dragonflies and Damselflies)

7.5.53 Much of the area within MPNR is brackish wetland habitat and hence does not support a diverse community of dragonflies. The species recorded in MPNR are all considered either abundant or common in Hong Kong (AFCD 2017), though seven are of conservation importance (***Appendix C6-1***).

7.5.54 The species of conservation importance recorded during the surveys in 2016, 2017 and 2019-20 were Coastal Glider, Blue Sprite, Ruby Darter, Scarlet Basker, Four-spot Midget, Eastern Lilysquatter and Mangrove Skimmer (***Appendices C6-2, C6-3, C6-4***). All are common in HK apart from two. Mangrove Skimmer is an uncommon species recorded in several locations, mainly in the Sai Kung area (AFCD 2017).

7.5.55 In addition, Four-spot Midget was recorded in the mangrove along the floating boardwalk outside the Boundary Fence. This species is considered as of Global Concern (Fellowes *et al*. 2002) and listed as Near Threatened by IUCN (2017). It was not recorded near any of the Project Elements.

Bent-winged Firefly

7.5.56 The numbers and distribution of *Pyrocoelia analis* and Bent-winged Firefly *Pteroptyx maipo* recorded by WWF are presented in ***Appendix C7-1***, while the number and distribution of Bent-winged Firefly recorded in verification surveys in 2020 is presented in ***Appendix C7-2*** and illustrated in ***Figure 7-10***. The distribution of Bent-winged Firefly is confined to the brackish water channel outside but immediately adjacent to the reserve along the southern and southeastern boundary, adjacent to ponds 22a, 22b, 23, 24a, 24c, 24 e-g and 19. The highest densities occurred adjacent to ponds 24e, f and g. At the nearest point, the area of occurrence is 340m from the footpath element to be upgraded; the shortest distance to TH2 is approximately 500m.

Aquatic Fauna

7.5.57 Maximum counts of fish recorded in gei wai and ponds at MPNR during benthic fauna verification surveys in 2019-20 are, for the sake of completeness, provided in ***Appendix C8-3***.

Benthic Fauna

7.5.58 A total of eight benthic taxa were identified from the samples collected in September 2017; among these, six were from the samples within the Project Site. The diversity of benthic fauna within the Project Site and outside the boundary fence is low. Detailed survey findings are provided in ***Appendix C9-1*** and ***Appendix C9-2***.

7.6 Habitat Evaluation

Introduction

7.6.1 This section provides an ecological evaluation of the habitats within the Assessment Area. The brackish *gei wai* and rain-fed ponds of MPNR are treated as comprising a single ‘habitat’ containing several linked microhabitats (see below). The portion of MPNR that comprises relatively homogenous intertidal mangroves outside the Boundary Fence, is ecologically very different, however; thus, it is evaluated separately below.

MPNR Brackish Gei Wai and Rain-fed Ponds (‘Project Site’)

7.6.2 MPNR brackish gei wai and rain-fed ponds contain a complex mosaic of wetland microhabitats, including former gei wai (brackish shrimp ponds), rain-fed ponds, reed marsh, emergent vegetation and mangroves, together with non-wetland areas including vegetated and bare ground, all of which are actively managed for wildlife. In addition, there are small areas of development, including service roads, footpaths and buildings such as MPEC and existing tower hides. The areas of each of these microhabitats are detailed in ***Table 7-19***, below, with their distribution within the Project Site shown on ***Figure 7-2***, which was generated from aerial photos and ground-truthing in 2020.

Table 7-19 Areas of Microhabitat in MPNR Brackish Gei Wai and Rain-fed Ponds 2020

HABITAT	AREA (HA)	%
Open Water (Gei Wai)	87.66	40.75
Open Water (Rain-fed)	28.59	13.29
Mangrove	27.05	12.57
Reedbed	26.90	12.50
Other Emergent Vegetation	6.27	2.91
Terrestrial Vegetation	29.92	13.91
Bare Ground	8.44	3.92
Buildings/ Facilities	0.30	0.14
Total	**215.13**	**100**

7.6.3 MPNR inside the boundary fence comprises a mosaic of different wetland and some non-wetland microhabitats that together provide habitats for a wildlife community that differs from and is more diverse than that which is present in large homogenous blocks of just one of the habitat types in the mosaic. The interconnectedness of the various microhabitats is complex and intimate, and for this reason we believe treating them as separate would not be the most accurate representation of their function. Evaluation of these components individually would provide a misleading picture of the overall value of the habitat mosaic and the management practices, which are to a substantial extent focussed on ponds, rather than habitats. In addition, the active conservation management results in many of these having a considerable higher value than physically superficially similar habitats elsewhere in the Assessment Area.

7.6.4 Accordingly, MPNR is evaluated as a single 'habitat' containing several linked microhabitats. Ecological evaluation of MPNR Brackish gei wai and Rain-fed Ponds is given in ***Table 7-20***. Where project elements potentially impact microhabitats, this will be addressed in the section addressing impact significance.

Table 7-20 Ecological Evaluation of MPNR Brackish Gei Wai and Rain-fed Ponds

CRITERIA	MPNR BRACKISH GEI WAI AND RAIN-FED POND
Naturalness	Originally a modified habitat mosaic but actively managed to enhance its natural features.
Size	Approximately 214ha in the Project Site.
Diversity	High diversity of fauna, especially birds, moderate diversity of flora.
Rarity	Actively managed wetlands are few in Hong Kong and MPNR is much the largest, thus rendering it unique in a local context and rare in a regional context.
Re-creatability	Potentially re-creatable, especially if baseline conditions include existing coastal wetland habitats such asfishponds, though some habitats such as mangroves would take some time to reach maturity and resource inputs would be high.
Fragmentation	Not fragmented.
Ecological linkage	Strong ecological linkages to other habitats in the Ramsar Site.
Potential value	Despite its high existing value, ongoing active management has the potential to increase value incrementally.
Nursery/breeding ground	Significant breeding ground for birds, aquatic invertebrates and fish.
Age	Actively managed as a nature reserve for just over 30 years.
Abundance/richness of wildlife	Bird diversity and abundance are high to very high especially during migration and winter seasons. Other faunal groups are also more abundant and diverse than in most Deep Bay wetland areas.
Ecological value	**Very High Ecological Value.**

Mangroves

7.6.5 The Assessment Area includes an extensive intertidal mangrove area outside the boundary fence that is contiguous with the extensive mangroves around Deep Bay. Most of the intertidal mangroves in the Assessment Area are within the reserve, while a small area around Lut Chau is not, but is protected by its being included in the Inner Deep Bay SSSI.

7.6.6 Mangrove habitats are important for their invertebrate and fish communities and are also used by a number of wetland bird species, though both numbers and diversity of the latter are lower than in either gei wai or rain-fed ponds inside the boundary fence, or the intertidal mudflats outside the Assessment Area. The endemic Bent-winged Firefly has recently been described from mangrove fringed tidal creeks around Deep Bay and occurs in such habitat in the Assessment Area. The ecological requirements of Bent-winged Firefly are not yet fully known (Ballantyne et al. 2011); however tidal creeks and the surrounding mangroves and wet grassland are important habitats Ecological evaluation of Mangroves is given in ***Table 7-21***, below. In recent years, the mangrove has supported a large egretry.

Table 7-21 Ecological Evaluation of Mangroves

CRITERIA	MANGROVE
Naturalness	A natural habitat in intertidal areas in Hong Kong.
Size	126.77ha in the Assessment Area of which 87.2ha are in MPNR.
Diversity	Low vegetation diversity but a high diversity of microhabitat and fauna, with many habitat-dependent invertebrate species.
Rarity	Mangroves are relatively common in Deep Bay intertidal areas. The mangroves in Deep Bay are of better quality than most remaining stands in south China. Habitat for the endemic Bent-winged Firefly.
Re-creatability	Could be re-created by planting in sheltered inter-tidal areas with suitable substrates but might take some time for establishment.
Fragmentation	Not fragmented.
Ecological linkage	Part of, and with very strong ecological links with the contiguous mangrove area around Deep Bay and intertidal mudflat areas.
Potential value	Value could be enhanced by removing exotic *Sonneratia* spp.
Nursery/breeding ground	Provides a breeding ground for mangrove fauna, including Bent-winged Firefly, and currently supports a large egretry that supported an estimated 557 nests in 2019. An important spawning ground for some marine fish and an important nursery ground for some fishes and shrimps.
Age	Age not known but is a well-established mangrove stand.
Abundance/richness of wildlife	Mangrove communities in Deep Bay are known to support a high diversity of fauna, especially invertebrates.
Ecological value	Part of, and continuous with, the extensive mangroves around Deep Bay and considered to be of **High Ecological Value.**

Commercial Fishponds

7.6.7 Fishponds are the dominant habitat in the Assessment Area outside MPNR. Most of these ponds, are actively maintained for the cultivation of fish species. Management includes periodic stocking and rearing and harvesting of fish, management of water quality and adjustment of pond profiles. Where fish harvesting is accomplished by draining down ponds, large waterbirds (including egrets and spoonbills) are frequently attracted into fishponds. Bund vegetation is regularly managed and is mostly maintained at very low levels. The dominant plant species are common grasses and ruderal herbs. Some trees are also present, especially fruit trees. To enable vehicular access, some fishpond bunds have been strengthened by import of fill material, limiting the colonisation of vegetation. Assessment of the ecological value of these active fishponds (and

indeed abandoned ponds) includes an evaluation of the bunds, which are an integral part of the pond structure and thus are a key element of wetland function.

7.6.8 Management of the active fishponds requires a significant amount of human and vehicular activity around the ponds. This leads to the disturbance of large waterbirds and other disturbance-sensitive wildlife. Fishponds operators are often resident on site, so some degree of disturbance is present throughout the day (albeit at significantly lower levels overnight). Dogs are often present, creating an additional source of disturbance to wildlife. Man-made structures and utility services around the fishponds further increase the levels of disturbance, whilst some ponds in the Assessment Area are wired to deter large waterbirds, in particular Great Cormorants, from feeding on fish stocks. Conversely, Management Agreements (MAs) supported by the Environment and Conservation Fund, whereby fishpond operators receive a subsidy if they follow a pond management protocol intended to increase the attractiveness of ponds to foraging waterbirds, have covered some ponds in the Assessment Area since 2012. However, there is no published information on where these MA protocols are in effect.

7.6.9 Several of the former fishponds in the Assessment Area, notably in the area to the south of Pak Hok Chau, have been abandoned (meaning that considerable effort would be required to bring them back into production). Some of these ponds have open water areas, but most have been at least partially overgrown with reeds, while the bunds are well-vegetated with trees, shrubs and grasses. Compared to active fishponds, the abandoned ponds receive considerably less human disturbance, increasing their value to disturbance-sensitive species. Thus, these ponds support a somewhat different wetland bird community to the active fishponds with larger numbers of cryptic species including bitterns and rails, while the bunds are often used by roosting and loafing ardeids. Conversely, these ponds lack the drain-down period of actively managed ponds and the fish stocks are expected to be lower than in commercial ponds. Ecological evaluation of Fishponds is given in ***Table 7-22***.

Table 7-22 Ecological Evaluation of Commercial Fishponds

CRITERIA	ACTIVE FISHPOND	ABANDONED FISHPOND
Naturalness	Man-made habitat with high levels of human activity.	Man-made habitat but now with low levels of human disturbance.
Size	Out of 167.82ha of ponds in the Assessment Area, approximately 91.6% are active.	Out of 167.82ha of ponds in the Assessment Area approximately 8.4% are abandoned.
Diversity	Low habitat and vegetation diversity but moderate diversity of fauna, especially birds.	Diversity of vegetation and microhabitats higher than in managed ponds, similar overall faunal diversity but species composition differs.
Rarity	Fishponds are a common habitat in the Deep Bay area but are becoming less common throughout Hong Kong.	Fishponds are a common habitat in the Deep Bay area but are becoming less common throughout Hong Kong. Blocks of contiguous abandoned fishponds with such low levels of human disturbance as those to the south of Pak Hok Chau are unusual.
Re-creatability	Easily re-creatable.	Easily re-creatable.
Fragmentation	Not fragmented.	Not fragmented.
Ecological linkage	Ponds have strong ecological linkage to nearby wetland habitats, including abandoned ponds and intertidal rivers. A pre-roost of ardeids is currently present in active fishponds near GW8a and 10.	Ponds have strong ecological linkage to nearby fishponds and other wetland habitats.

CRITERIA	ACTIVE FISHPOND	ABANDONED FISHPOND
Potential value	Value could be increased by more ecologically-friendly management methods. The MAs may be effective in this respect. However, value may also decrease if fisheries management becomes more intensive.	Value could be increased by more ecologically-friendly management methods. However, value may also decrease (or, at least, change) if fisheries management is resumed and becomes intensive.
Nursery/breeding ground	No significant nursery or breeding grounds.	No significant nursery or breeding grounds known but doubtless supports breeding wetland-dependent fauna including disturbance-sensitive species.
Age	Not known but moderately old.	Not known but moderately old.
Abundance/richness of wildlife	Some waterbird species, notably ardeids, are routinely present in moderate numbers and may be abundant during pond-drain down. Low abundance and diversity of other fauna (dragonflies and amphibians).	Abundance generally of waterbirds typically lower than in active ponds but this is partly a function of species using this habitat being more solitary than those which favour active ponds; other faunal groups, such as amphibians, generally more abundant and diverse than in managed ponds.
Ecological value	In their current state the ponds attract moderate numbers and diversity of wetland species, although some wetland birds are present in good numbers and the ecological linkages are good; these active ponds are therefore considered currently to be of moderate to high importance. Given their scale and location and their ecological linkages to MPNR, there is considerable potential to improve these ponds by MAs and similar means and taking this potential value into account, these ponds are considered to be of **High Ecological Value.**	These abandoned ponds support smaller numbers of birds of conservation importance than active ponds. However, taking into account their value for other wetland fauna, the fact that they support a different suite of wetland birds to active ponds, the relatively large area and its freedom from disturbance, these ponds are considered to be of **High Ecological Value.**

Brackish Marshes and Natural Watercourses

7.6.10 Brackish marsh is present in the Assessment Area in association with natural watercourses. The most important watercourse is that which flows from Fairview Park, around the southeast boundary of MPNR and then between the Reserve and Lut Chau, before joining the Kam Tin River in the extreme southeast of the Assessment Area. In addition, two smaller watercourses discharge into the Shenzhen River to the north of Tam Kon Chau. Natural watercourse and brackish marsh habitats are intimately linked in this Assessment Area, hence are evaluated here as an ecological unit. The watercourse channels are intertidal, at least at spring tides; hence the linked marsh areas are periodically inundated with brackish water, a feature which has an important influence on the marsh floral and faunal communities.

7.6.11 Fauna present include moderate numbers and diversity of bird species, including small numbers of ardeids, rails and wetland-dependent or associated passerines, such as Oriental Reed, Black-browed Reed and Dusky Warblers. Perhaps the most significant fauna species present is Bent-winged Firefly, which is present in large numbers in the brackish marsh between MPNR and Fairview Park, in particular. Ecological evaluation of Brackish Marshes and Natural Watercourses is given in ***Table 7-23***, below.

Table 7-23 Ecological Evaluation of Brackish Marshes and Natural Watercourses

CRITERIA	BRACKISH MARSHES AND NATURAL WATERCOURSES
Naturalness	Natural habitat with few recent anthropogenic influences.
Size	Within the Assessment Area there are 21.66ha of brackish marsh and 17.02ha of natural watercourse. Moderate in size when taken in combination; but watercourses are narrow with little open water. These habitats are not present in the Project Site.
Diversity	Low diversity of microhabitat types but reasonably high faunal diversity, especially birds and invertebrates.
Rarity	Habitat is relatively rare in Hong Kong, and many areas are threatened by anthropogenic activities and succession. Most species using this habitat are not rare, but some are habitat specialists, notably Bent-winged Firefly.
Re-creatability	Could be re-created at a suitable location by restoring channelised watercourse and adjacent habitats.
Fragmentation	Not fragmented.
Ecological linkage	Ecologically linked to mudflats and mangrove and fishpond areas, but upstream linkages are blocked by channelised watercourse and urban development.
Potential value	Could be enhanced by conservation management and reduction in pollution load to watercourses.
Nursery/breeding ground	Breeding area for Bent-winged Firefly.
Age	Not known, but area between MPNR and Fairview Park probably formed not long after estate construction, hence around 40 years old.
Abundance/richness of wildlife	High abundance and diversity of wetland birds and some invertebrate groups.
Ecological value	Considered to be of **High Ecological Value**, especially in view of its importance for Bent-winged Firefly.

Channelised Watercourses

7.6.12 One channelised watercourse is present in the Assessment Area. This is a concrete u-shaped channel that flows through Fairview Park and joins the natural watercourse to the southeast of MPNR. Its ecological value is severely constrained by the absence of vegetation and the proximity of residential and other developments. Ecological evaluation of Channelised Watercourses is given in ***Table 7-24***.

Table 7-24 Ecological Evaluation of Channelised Watercourses

CRITERIA	CHANNELISED WATERCOURSE
Naturalness	Entirely man-made.
Size	Narrow. None is within the Project Site. Area only 1.0ha.
Diversity	Low diversity of microhabitat types and low faunal diversity.
Rarity	Habitat is common in Hong Kong. Used by small numbers of bird species of conservation importance on a casual basis.
Re-creatability	Readily re-creatable.
Fragmentation	Not fragmented.
Ecological linkage	No significant ecological linkages, but hydrologically linked to natural watercourse downstream.
Potential value	Could be enhanced by re-engineering to create a more ecologically diverse channel but little likelihood of this taking place.
Nursery/breeding ground	Not suitable as a nursery/breeding ground.

CRITERIA	CHANNELISED WATERCOURSE
Age	Presumably formed when Fairview Park was built, hence around 40 years old.
Abundance/richness of wildlife	Low abundance and diversity of fauna, no macroflora.
Ecological value	**Low Ecological Value.**

Wooded Area

7.6.13 Two small areas of secondary woodland are present in the Assessment Area: immediately to the north of the former PSFSC and around Tam Kon Chau Police Post; and at Shek Shan, an area between the Boundary Road and the Boundary Fence. Both of these areas are dominated by naturally regenerated native tree species, in particular *Ficus microcarpa*. . The wooded area to the north of the PSFSC site supported an egretry utilised by Chinese Pond Herons from 2000 to 2008; the number of nests peaked at 47 in 2004 (HKBWS data). A pair of Chinese Blackbirds, which is a rare breeding species in Hong Kong, has bred in this wood in 2017 (this study). A *Livistona chinensis* tree in this wood is utilised as a roost site by Short-nosed Fruit Bat (ibid). Ecological evaluation of Wooded Areas is given in ***Table 7-25***.

Table 7-25 Ecological Evaluation of Wooded Areas

CRITERIA	WOODED AREA
Naturalness	Naturally regenerated but some anthropogenic influences and planted/exotic species present.
Size	Small: 0.89ha in the Assessment Area; none is within the Project Site.
Diversity	Low diversity of woody flora and resident fauna due to small size.
Rarity	Disturbed secondary woodland is a common habitat in Hong Kong.
Re-creatability	Can be re-created in suitable locations, although trees would take a long time to reach maturity.
Fragmentation	Internally fragmented by buildings; fragmented from other woodland habitats by wetland areas.
Ecological linkage	Utilised as roosting sites by birds foraging in adjacent wetland areas; wooded area north of PSFSC was formerly utilised by breeding Chinese Pond Herons.
Potential value	Value will increase naturally over time as trees mature; areas around former PSFSC could be increased if brought under conservation management.
Nursery/breeding ground	Wooded area north of PSFSC site currently used by night roosting ardeids, breeding Azure-winged Magpies and Chinese Blackbird and roosting Short-nosed Fruit Bats.
Age	Uncertain but many trees are large.
Abundance/richness of wildlife	Low abundance but moderate diversity of fauna, notably birds.
Ecological value	Most trees are native but small areas and disturbance compromises the habitat value to some extent, thus assessed as of **Moderate Ecological Value**.

Developed Areas

7.6.14 The southeastern part of the Assessment Area includes part of the developed area of Fairview Park, a low-rise housing development. Elsewhere in the Assessment Area developed areas largely comprise small groups of domestic structures and farm structures, together with government, institutional and community facilities, including those associated with MPNR, such as MPEC, the latter being located in the Project Site along with a number of birdwatching hides and service structures. In addition to areas occupied by structures, the single track Boundary Road runs around the north and west sides of the Project Site, whilst northeast side of the Project Site comprises the concrete footpath which serves MPEC.

7.6.15 The environs of domestic structures around Tam Kon Chau are well vegetated with ornamental trees, shrubs and fruit trees that attract a moderate number and diversity of mostly common and widespread bird and butterfly species, but include nesting White-shouldered Starlings, which breed in nest boxes and electrical installations, and appear to be largely dependent on man-made breeding sites in Hong Kong (Carey *et al.* 2001); whilst some structures may be utilised by roosting bats. Ecological evaluation of Developed Areas is given in ***Table 7-26***.

Table 7-26 Ecological Evaluation of Developed Areas

CRITERIA	DEVELOPED AREA
Naturalness	An artificial, man-made habitat.
Size	Fairview Park occupies a relatively large part of the southeast of the Assessment Area, other developed areas are small; the habitat occupies 55.07ha in the Assessment Area.
Diversity	A low to moderate diversity of vegetation managed for cultivation and ornamental purposes around houses.
Rarity	A common habitat in Hong Kong.
Re-creatability	Easily re-creatable.
Fragmentation	Except for Fairview Park, most developed areas in the Assessment Area are rather fragmented and do not pose a significant barrier to faunal movement; the narrow Boundary Road is lightly used by a small number of permitted police and service vehicles. However, fences around commercial fishponds, together with the Boundary Fence, may pose a barrier to movement of some terrestrial fauna species.
Ecological linkage	No significant ecological linkages.
Potential value	Little scope for an increase in ecological value.
Nursery/breeding ground	Some structures are used by breeding White-shouldered Starlings and perhaps by bats.
Age	Fairview Park development is over 40 years old; most other areas occupied by structures have been developed for many years, with little recent change in the areas and extent of development. However, there has been an increase in the area occupied by on-farm structures in recent years, especially to the south of Tam Kon Chau.
Abundance/richness of wildlife	Moderate abundance and diversity of bird and butterfly species associated with domestic and farm structures; most species are habitat-generalists but the locally distributed White-shouldered Starling appears to be largely dependent upon anthropogenic breeding sites in Hong Kong.
Ecological value	In general, developed areas are of **Low Ecological Value**; however, the domestic structures and their environs at Tam Kon Chau are considered to be of **Low to Moderate Ecological Value** in view of their importance to breeding White-shouldered Starlings**.**

7.7 Species Evaluations

Avifauna

7.7.1 Approximately 370 species of bird have been recorded in MPNR, of which 50 are of global conservation importance. Due to their dependence on wetland habitats and the threats to wetlands regionally, many wetland-dependent species are assessed as of conservation importance. Large waterbirds such as cormorants, egrets, herons and spoonbills are of particular significance in a Mai Po context, as it supports a large proportion of the Deep Bay area and/or regional population. Of especial importance in the context of this Study and the areas where project elements are located are the following species (threat status available at www.iucnredlist.org):

- **Black-faced Spoonbill.** Listed as Endangered by IUCN, MPNR is a core component of its range in the winter in HK, primarily in terms of the undisturbed roost site that it occupies.

- **Greater Spotted and Imperial Eagle.** Listed as Vulnerable by IUCN, they occur in small numbers in the Deep Bay area. Daytime roosting appears to be an important feature of their use of MPNR, while foraging opportunities are provided by the large number of ducks in MPNR.
- **Collared Crow.** Listed as Vulnerable by IUCN, MPNR is a key site for this species as it supports breeding birds and a year-round roost in the intertidal mangrove.
- **Manchurian Reed Warbler.** Listed as Vulnerable by IUCN, this species occurs in low numbers in the reed marsh on autumn passage.

7.7.2 In terms of overall conservation importance, waterbirds in general and the group of species listed above in particular must be rated as **High**.

Non-bird fauna

7.7.3 ***Table 7-27 to Table 7-31***, below, assess the ecological value of non-bird species of conservation importance recorded historically in MPNR and species recorded as part of surveys carried out for this Study. Species recorded outside MPNR that had not already been recorded inside are indicated with a double asterisk; species that have been recorded in MPNR and in the Assessment Area outside MPNR are indicated with a single asterisk, in both cases with the habitat indicated. Notes applicable to all tables are provided below the last ***Table 7-31***.

Table 7-27 Ecological Evaluation of Mammals

COMMON NAME	SCIENTIFIC NAME	CONSERVATION / PROTECTION STATUS[NOTE 1]	DISTRIBUTION IN HONG KONG[NOTE 2]	RARITY[NOTE 3]	ECOLOGICAL VALUE
Leschenault's Rousette	*Rousettus leschenaulti*	(LC); Cap.170	Fairly widely distributed in rural areas	Common	Medium
Short-nosed Fruit Bat* (DA)	*Cynopterus sphinx*	RLCV(NT); Cap.170	Widely distributed in urban and rural areas	Very Common	Medium
Intermediate Horseshoe Bat	*Rhinolophus affinis*	(LC); Cap.170	Widely distributed in rural areas	Uncommon	Medium
Least Horseshoe Bat	*Rhinolophus pusillus*	PRC (RC); Cap.170	Widely distributed in rural areas	Uncommon	Medium
Horsfield's Myotis	*Myotis horsfieldii*	PRC (RC); Cap.170	Found in Shek Kong, Pak Tam Chung, Fung Yuen, & Plover Cove, Pat Sin Leng and Shing Mun CP	Rare	Medium
Chinese Noctule	*Nyctalus plancyi*	PRC (RC); Cap.170	Fairly widely distributed in rural areas	Common	Medium
Least Pipistrelle	*Pipistrellus tenuis*	RLCV(NT); Cap.170	10-20 records in rural NT	Uncommon	Medium
Chinese Pipistrelle	*Hypsugo pulveratus*	(LC); RLCV(NT); Cap.170	Several records in rural NT; also records stray individuals in buildings	Rare	Medium
Lesser Bamboo Bat	*Tylonycteris pachypus*	(LC); Cap.170	Fairly widely distributed in rural areas	Very Common	Medium
Lesser Yellow Bat	*Scotophilus kuhlii*	(LC); Cap.170	Fairly widely distributed in rural areas	Uncommon	Medium
Greater Bent-winged Bat	*Miniopterus magnater*	PRC (RC); RLCV(NT); Cap.170	Data deficient	Data Deficient	High
Lesser Bent-winged Bat	*Miniopterus pusillus*	(LC); RLCV(NT); Cap.170	Fairly widely distributed in rural areas	Uncommon	Medium
Common Bent-winged Bat	*Miniopterus schreibersii*	(LC); IUCN(NT); Cap.170	Widely distributed in rural areas	Common	Medium
Himalayan Leaf-nosed Bat	*Hipposideros armiger*	(LC); Cap.170	Widely distributed in rural areas	Very Common	Medium
Rhesus Macaque	*Macaca mulatta*	CSMPS(II); CITES(II); Cap.170; Cap.586	Mainly Kam Shan, Shing Mun and Tai Po Kau; also Ma On Shan, Sai Kung, Tai Lam	Common	Medium

COMMON NAME	SCIENTIFIC NAME	CONSERVATION / PROTECTION STATUS[NOTE 1]	DISTRIBUTION IN HONG KONG[NOTE 2]	RARITY[NOTE 3]	ECOLOGICAL VALUE
			Country Parks and North District		
Greater Bandicoot Rat	*Bandicota indica*	LC	Found Mai Po, Pat Sin Leng Country Park and Lantau	Rare	Medium
East Asian Porcupine	*Hystrix brachyura*	PGC; Cap.170	Widely distributed in rural areas, except Lantau	Very Common	Low
Eurasian Otter	*Lutra lutra*	RC; RLCV(EN); IUCN(NT); CSMPS(II); CITES(I); Cap.170; Cap.586	Restricted to Mai Po, Hoo Hok Wai, and nearby areas	Rare	High
Small Indian Civet	*Viverricula indica*	RLCV(VU); CSMPS(II); CITES(III); Cap.170; Cap.586	Widely distributed in rural areas, except Lantau	Very Common	High
Small Asian Mongoose	*Herpestes javanicus*	RLCV(VU); CITES(III); Cap.170; Cap.586	Fairly widely distributed in rural NT	Uncommon	High
Leopard Cat	*Prionailurus bengalensis*	RLCV(VU); CITES(II); Cap.170; Cap.586	Widely distributed in rural areas, except for Lantau Island	Uncommon	High

Table 7-28 Ecological Evaluation of Herpetofauna

COMMON NAME	SCIENTIFIC NAME	CONSERVATION / PROTECTION STATUS[NOTE 1]	DISTRIBUTION IN HONG KONG[NOTE 2]	ECOLOGICAL VALUE
Malayan Box Turtle	*Cuora amboinensis*	IUCN(VU); CITES(II); Cap.586	Released individuals found in some parts of NT	Medium
Reeves' Turtle	*Mauremys reevesii*	GC; RLCV(EN); IUCN(EN); CITES(III); Cap.170; Cap.586	Widespread in the territory Used to be a common species but sightings have been rare in recent years Found in most local reservoirs	High
Chinese Soft-shelled Turtle	*Pelodiscus sinensis*	GC; RLCV(EN); IUCN(VU); Cap.170	Locally found in reservoirs and fishponds in Deep Bay area	Medium
Four-clawed Gecko	*Gehyra mutilata*	RLCV(VU)	Widely distributed throughout Hong Kong	Low
Copperhead Racer	*Coelognathus radiatus*	PRC; RLCV(EN)	Widely distributed throughout Hong Kong	Medium
Taiwan Kukri Snake	*Oligodon formosanus*	RLCV(NT)	Widely distributed throughout Hong Kong	Medium
Indo-chinese rat snake* (DA)	*Ptyas korros*	PRC; RLCV(VU)	Widely distributed throughout Hong Kong	Medium
Common Rat Snake	*Ptyas mucosus*	PRC; RLCV(EN); CITES(II); Cap.586	Widely distributed throughout Hong Kong	High
Banded Krait	*Bungarus fasciatus*	RC; RLCV(EN)	Distributed in few localities of the NT, Hong Kong Island and Lantau Island	Medium
Many-banded Krait* (DA)	*Bungarus multicinctus*	PRC; RLCV(EN)	Widely distributed in NT, Hong Kong Island and Lantau Island	Medium
Chinese Cobra	*Naja atra*	PRC: RLCV(VU); IUCN(VU); CITES(II); Cap.586	Found throughout the territory	High

COMMON NAME	SCIENTIFIC NAME	CONSERVATION / PROTECTION STATUS[NOTE 1]	DISTRIBUTION IN HONG KONG[NOTE 2]	ECOLOGICAL VALUE
King Cobra	*Ophiophagus hannah*	PRC: RLCV(EN); IUCN(VU); CITES(II); Cap.586	Widely distributed throughout Hong Kong	High
Mangrove Water Snake	*Myrrophis bennettii*	LC	Recorded in the muddy coastal areas in Deep Bay area	Medium
Chinese Water Snake	*Myrrophis chinensis*	RLCV(VU)	Distributed in freshwater or brackish wetlands in central and northern NT	Medium
Burmese Python	*Python bivittatus*	PRC; RLCV(CR); IUCN(VU); CITES(II); CSMPS(I); Cap.170; Cap.586	Widely distributed throughout Hong Kong	High
Spotted Narrow-mouthed Frog	*Kalophrynus interlineatus*	RLCV(NT)	Widely distributed from low to moderate altitudes in northern and central NT	Medium
Chinese Bullfrog	*Hoplobatrachus rugulosus*	PRC; RLCV(EN); CSMPS(II)	Widely distributed in Lantau Island and NT	Medium

Table 7-29 Ecological Evaluation of Mai Po Bent-winged Firefly and Dragonflies

COMMON NAME	SCIENTIFIC NAME	CONSERVATION / PROTECTION STATUS[NOTE 1]	DISTRIBUTION IN HONG KONG[NOTE 2]	RARITY[NOTE 3]	ECOLOGICAL VALUE
Mai Po Bent-winged Firefly	*Pteroptyx maipo*	-	Deep Bay only. Endemic.	Locally common	High
Asian Bluetail	*Ischnura asiatica*	-	Historical record in 1865 (Brauer 1865)	Rare	Medium
Four-spot Midget* (MAN)	*Mortonagrion hirosei*	GC; IUCN(NT)	Double Island, Luk Keng, Mai Po Marshes, Nam Chung, Sam A Tsuen and Sha Po	Common	High
Eastern Lilysquatter	*Paracercion melanotum*	LC	Hong Kong Wetland Park, Lai Chi Wo, Luk Keng and Shek Kwu Chau	Common	Medium
Blue Sprite	*Pseudagrion microcephalum*	LC	Kai Kuk Shue Ha, Kau Sai Chau, Lai Chi Wo, Mai Po, Mui Wo, River Jhelum and Tung Ping Chau	Common	Medium
Blue-spotted Dusk-hawker	*Gynacantha japonica*	LC	Hoi Ha, Ngong Ping, Sha Lo Tung and Wu Kau Tang	Common	Medium
Little Dusk-hawker	*Gynacantha saltatrix*	LC	Kau Sai Chai, Ping Yeung, Tai Po Kau, Tsim Sha Tsui and Yeung Ka Tsuen	Uncommon	Medium
Dingy Dusk-hawker	*Gynacantha subinterrupta*	LC	Hong Kong Wetland Park, Lantau, Ping Shan Chai, Sha Lo Tung and Tai Mo Shan	Common	Medium
Tawny Hooktail	*Paragomphus capricornis*	RC	Lion Rock Country Park, Tai Lam Chung Country Park, Tai Tong and Yeung Ka Tsuen	Uncommon	Medium

COMMON NAME	SCIENTIFIC NAME	CONSERVATION / PROTECTION STATUS[NOTE 1]	DISTRIBUTION IN HONG KONG[NOTE 2]	RARITY[NOTE 3]	ECOLOGICAL VALUE
Black-tipped Percher	*Diplacodes nebulosa*	LC	Lamma Island, Lo Wu, Luk Keng, Sum Wut and Yuen Long.	Uncommon	Medium
Coastal Glider	*Macrodiplax cora*	LC	Hong Kong Wetland Park, Kam Tin, Lai Chi Wo, Nim Wan and Luk Keng	Common	Medium
Mangrove Skimmer* (MAN)	*Orthetrum poecilops*	GC; IUCN(VU)	Double Island, Lai Chi Wo, Nam Chung, So Lo Pun, Yim Tso Ha (Starling Inlet), Yung Shue au and Yung Shue O	Uncommon	High
Blue Chaser	*Potamarcha congener*	LC	Widely distributed in marsh throughout Hong Kong	Common	Medium
Scarlet Basker	*Urothemis signata*	LC	Common in areas containing abandoned fishponds throughout Hong Kong	Common	Medium
Ruby Darter** (Pond)	*Rhodothemis rufa*	LC	Widely distributed in ponds and marshes throughout Hong Kong.	Common	Medium

Table 7-30 Ecological Evaluation of Butterflies

COMMON NAME	SCIENTIFIC NAME	CONSERVATION / PROTECTION STATUS[NOTE 1]	DISTRIBUTION IN HONG KONG[NOTE 2]	RARITY[NOTE 3]	ECOLOGICAL VALUE
Swallowtail	*Papilio xuthus*	-	Kap Lung, Ma On Shan, Tai Tam, Sha Lo Wan, Kat O, Lung Kwu Tan, Wu Kau Tang, Lung Kwu Chau	Rare	Medium
Common Birdwing	*Troides helena*	CITES(II); Cap.170; Cap.586	Widely distributed throughout Hong Kong	Uncommon	High
Chocolate Albatross	*Appias lyncida*	LC	Kam Tin	Very Rare	Medium
Small Cabbage White* (WA)	*Pieris rapae*	-	Shep Mun Kap, Fan Lau, Ngong Ping, Kam Tin, Ho Chung, Luk Keng, Tuen Mun Ash Lagoon	Rare	Medium
Colon Swift	*Caltoris bromus*	-	-	Very Rare	Medium
Common Awl* (MAN)	*Hasora badra*	LC	Wu Kau Tang, Lai Chi Wo, Hong Kong Wetland Park	Very Rare	Medium
Banded Awl	*Hasora chromus*	-	Sham Wat, Lai Chi Wo, Po Toi	Rare	Medium
Lesser Band Dart	*Potanthus trachala*	-	Widely distributed in grassland throughout Hong Kong	Rare	Medium
Pale Palm Dart	*Telicota colon*	LC	Widely distributed in grassland and shrubland throughout Hong Kong	Rare	Medium
Powdered Oak Blue	*Arhopala bazalus*	-	Shing Mun, Yung Shue O, Tai Po Kau, Mount Nicholson, Victoria Peak	Rare	Medium

COMMON NAME	SCIENTIFIC NAME	CONSERVATION / PROTECTION STATUS[NOTE 1]	DISTRIBUTION IN HONG KONG[NOTE 2]	RARITY[NOTE 3]	ECOLOGICAL VALUE
Burmese Bush Blue	*Arhopala birmana*	LC	Ma On Shan, Tsiu Hang, Shan Liu, Lai Chi Shan, Yung Shue O	Very Rare	Medium
Forget-me-not* (WA)	*Catochrysops strabo*	-	Pui O, Tai Po Kau, Fung Yuen, Shing Mun, Sha Lo Wan	Very Rare	Medium
Cornelian	*Deudorix epijarbas*	-	Lam Tsuen, Shan Liu, Wu Kau Tang, Pak Sha O, Fung Yuen	Rare	Medium
Common Onyx	*Horaga onyx*	-	Common and widespread throughout rural area in Hong Kong	Rare	Medium
White Royal	*Pratapa deva*	-	Tai Po Kau, Pokfulam, Kuk Po, Pak Sha O, Victoria Peak, Wu Kau Tang, Fung Yuen	Very Rare	Medium
Danaid Egg-fly	*Hypolimnas misippus*	LC	Ngau Ngak Shan, Lung Kwu Tan, Hong Kong Wetland Park, Mount Parker, Cloudy Hill, Lin Ma Hang	Uncommon	Medium
Painted Lady	*Vanessa cardui*	LC	Widely distributed throughout Hong Kong	Rare	Medium
Grass Demon** (Brackish gei wai)	*Udaspes folus*	-	Widely distributed in farmland throughout Hong Kong	Rare	Medium

Table 7-31 Ecological Evaluation of Fish

COMMON NAME	SCIENTIFIC NAME	CONSERVATION / PROTECTION STATUS[NOTE 1]	DISTRIBUTION IN HONG KONG[NOTE 2]	ECOLOGICAL VALUE
Japanese Eel	*Anguilla japonica*	RLCV(EN); IUCN(EN)	Records from Lantau Island, Hong Kong Island, Sai Kung and Tsuen Wan in low abundance	High
Small Snakehead	*Channa asiatica*	LC	Uncommon in the wild. Records from a few streams in North district and on Lantau Island. Also cultivated in fish farms and are available from fish market	Medium
Common Carp	*Cyprinus carpio*	IUCN(VU)	-	Medium
Topmouth Gudgeon	*Pseudorasbora parva*	LC	Uncommon in streams and reported in several streams in North District. Considered a pest in Mainland China and available locally as fish food	Medium
-** (Pond)	*Gobiopterus macrolepis*	RLCV(VU)	-	Medium

Notes (all tables):

1. Conservation and Protection Status refers to Fellowes et al. (2002), Red List of China's Vertebrates (RLCV) (Jiang *et al.* 2016), IUCN (2020), China State Major Protection Status (CSMPS) (2018), CITES (2020), Cap. 170, and Cap. 586.
    - Conservation status by Fellowes *et al.* (2002): LC = Local Concern; PRC = Potential Regional Concern; RC = Regional Concern; PGC = Potential Global Concern; GC = Global Concern. Letters in Parentheses indicate that assessment is on the basis of restrictedness in breeding and/or roosting sites rather than general occurrence.

- Conservation status by Red List of China's Vertebrates (RLCV) (Jiang *et al.* 2016): NT= Near Threatened; VU = Vulnerable; EN = Endangered; CR = Critically Endangered.
- Conservation status by the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (2020): NT = Near Threatened; VU = Vulnerable; EN = Endangered; CR = Critically Endangered.
- Protection status by China State Major Protection Status (CSMPS) (2018): II = Class II Protected Species in China.
- Protection status by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (2020): I = Listed in CITES Appendix I; II = Listed in CITES Appendix II; III = Listed in CITES Appendix III.
- Protection status by Cap. 170 = Chapter 170. Wild Animals Protection Ordinance.
- Protection status by Cap. 586 = Chapter 586. Protection of Endangered Species of Animals and Plants Ordinance.

2. Distribution follows Hong Kong Biodiversity Database (AFCD, 2020).
3. Habitats in the Assessment Area outside MPNR at which the indicated species were recorded are: DA – Developed Area; MAN – Mangrove; WA – Wooded Area.

7.8 Potential Ecological Impacts

Introduction

7.8.1 In this section details are provided as to how design and construction methods of the preferred development have considered the need to avoid ecological impacts where feasible. The significance of any unavoidable direct and indirect, primary and secondary, on-site and off-site and fragmentation impacts of the project are then assessed and the proposed mitigation measures to minimise or compensate for these potential impacts are described. For the purposes of the impact assessment, it is considered that current conditions represent the baseline against which potential impacts are assessed.

7.8.2 Due to changes in the project timetable the demolition and rebuild of PSFSC (outside the Project Site) will be completed prior to construction at MPNR commencing.

Measures to Avoid and Minimise Impacts

7.8.3 The following measures have been adopted to avoid and/or minimise impacts.

- **External Construction Works During Wet Season Only**. The three project elements will be assembled/constructed over a two-month period between mid-April and mid-October, thus avoiding impacts on the high number of waterbirds and wetland-dependent species present in the dry season. This is, perhaps, the most significant of the impact avoidance measures.
- **Off-Site Prefabrication of Building Components**. To minimise impacts to ecologically sensitive areas, activities within MPNR will mainly concern assembly of prefabricated items.
- **Construction of New TH2**. The location of the new TH2 has been chosen primarily to enhance visitor experience by allowing more serious birdwatchers to view a section of the Reserve that has not previously been visible to visitors. The exact location has been chosen to avoid loss of wetland (gei wai) area, the need to avoid loss of existing trees, both arising from the construction of the hide itself and the access route, to allow researchers to survey the birds in the southern part of MPNR, and to minimise the requirement for new footpath for access.
- **Construction of New TH3**. The new TH3 will provide a new tower hide near the entrance of the MPNR for nature education particularly for families, students and those not disposed to long walks. As with TH2, the location has been chosen on an existing bund to avoid wetland loss and loss of existing trees.
- **Construction of Footpath**. The location of this Project element is fixed, as it is situated above the existing footpath. However, the proposed footpath has been designed to avoid intrusion into wetland areas (either gei wai or rain-fed ponds) and to avoid felling of existing trees. In addition, construction will be carried sequentially in three phases in order to minimise disturbance impacts and will cease a minimum of one hour prior to sunset.
- **Construction Access**. To avoid habitat loss impacts, construction access will occur along the existing Boundary Fence Road and via existing pond/gei wai bunds. Haul roads are shown on ***Figure 7-2***. Transport of construction materials will occur over a two-month period between mid-April and mid-October.

- **Tower Hide Design**. This will allow visitors to be close to disturbance-sensitive species with minimum impact.
- **Completion of pond draindown before commencing work**. In order to ensure that there are no disturbance impacts on birds attracted to ponds that are being drained down, construction will only commence once the pond is fully drained.

Permanent Direct Habitat Loss due to Construction and Operation

7.8.4 In accordance with the requirements of TPB PG No. 12C there will be no loss of wetland function resulting from the Project arising from either direct habitat loss or adverse disturbance impact. Only a very small amount of permanent direct habitat loss will arise. New hide construction will require the permanent loss of approximately 120m^2 of bund (100m^2 of gei wai bund and 20m^2 of rain-fed pond bund), which will be along gei wai 9 and 19. Widening of the main footpath from 1.5m to 1.65m together with formation of the Education Areas (EAs) will result in permanent loss of approximately 100m^2 of gei wai bund and 40m^2 of rain-fed pond bund. In addition, the new footpaths leading to TH2 and TH3 will be built on vegetated bunds and result in a loss of approximately 290m^2 of gei wai bund and 110m^2 of rain-fed pond bund. Direct habitat loss is detailed in ***Table 7-32***, and the impact of this direct habitat loss is evaluated in ***Table 7-33***.

Table 7-32 Change in Habitat Areas in the Project Site

HABITAT		CURRENT AREA (ha)	AREA AFTER WORKS	NET CHANGE	SOURCE OF LOSS
Brackish gei wai	Bund	19.74	19.69	-490m^2 / -0.05ha	Paths to TH2/TH3: 290m^2 GW9/19: 100m^2 Footpath: 100m^2
	Non-bund	143.06	143.06	0.00ha	
Rain-fed Pond	Bund	6.54	6.52	-170m^2 / -0.02ha	Paths to TH2/TH3: 110m^2 GW9/19: 20m^2 Footpath: 40m^2
	Non-bund	44.66	44.66	0.00ha	
Developed Area		2.76	2.81	+660m^2 / +0.07ha	
	Total	**216.76**	**216.76**	**0.00**	

Table 7-33 Direct Permanent Loss of Brackish Gei Wai Bund and Rain-fed Pond Bund

CRITERIA	ASSESSMENT
Habitat Quality	Brackish gei wai and rain-fed ponds are both of very high ecological value. However, the bunds are of much lower value as they are heavily disturbed by desilting works every few years and the vegetation is dominated by ruderal terrestrial species including the invasive exotic *Mikania micrantha*.
Species	The affected bunds are little used by waterbirds as they are either already moderately to heavily disturbed by visitors (the sections along the existing footpath and alongside GW9) or are unsuitable as a roost or foraging site due to being heavily vegetated (footpath to TH2). With regard to habitat loss at TH3, this area is too close to the footpath to provide an attractive roost site to waterbirds, and the footprint of TH2 is too vegetated. Bird species diversity, especially that of waterbirds (which, as a group, are of high ecological value), using the bunds to be impacted is low to moderate due also to small area, heavy disturbance by desilting works every few years and the presence of the invasive *Mikania* and other ruderal species. Diversity of other fauna is low.
Size/Abundance	The area to be lost (approximately 0.07ha of bund) is small, both in absolute terms and relative to the area of these habitats within MPNR. The number of individuals of flora and fauna that will be impacted is correspondingly small.
Duration	Habitat will be permanently lost to new bird hides.
Reversibility	Removal of structures and restoration of natural bund vegetation would be easy to accomplish in principle but is unlikely in practice.

CRITERIA	ASSESSMENT
Magnitude	Magnitude will be relatively low as only a very small area (approximately 0.07ha of bund, 0.033% of these habitats) will be converted to developed areas.
Impact Severity	Impact severity would be **Low to Moderate** in both construction and operational phases of the project in view of the relatively small area and the relatively low value usage of the land lost. It is considered there will be limited loss of wetland function.

Construction Phase Direct Impacts on Habitats

7.8.5 In addition to habitat lost permanently as described above, habitat will be lost temporarily during the construction phase of the Project, which will be the last week of April and first half of May, and September and the first half of October. These impacts are evaluated below.

TH2

7.8.6 To construct TH2, it is necessary to temporarily drain down Ponds 19 and 20e. This drain-down will be conducted during the first wet season of the Project in accordance with the rolling pond and gei wai desilting programme specified in the *MPNR Management Plan 2019-2024*, and hence does not constitute an additional impact arising from the Project. Water levels will be restored to normal dry season operating levels at the end of the wet season.

7.8.7 The works area for TH2 and its associated footpath will occupy approximately 1,560m^2, which it is assumed will be temporarily cleared ground during the 2021 wet season. As with drain-down, temporarily cleared ground constitutes a normal element of the routine pond and gei wai desilting programme and hence does not constitute an additional impact due to the Project.

TH3

7.8.8 Construction of TH3 will require the temporary drain-down of Pond 8a and GW 7. Again, this drain-down will be conducted during the first wet season of the construction phase in accordance with the rolling pond and gei wai desilting programme specified in the *MPNR Management Plan 2019-2024*, hence does not comprise additional impact arising from the Project. Water levels will be restored to normal dry season operating levels at the end of the wet season. According to the original *MPNR Management Plan 2019-2024*, GW #7 was drained in the wet season of 2020 to carry out "Desilting of channels and open water restoration at GW #7". In 2020, the Mai Po Management Committee advised that GW #8a and GW #7 should be connected with a sluice gate when the GW #8a enhancement is carried out. Therefore, GW #7 will need to be drained again to facilitate the construction of sluice gate in the summer of 2022. The construction programme for this Project has been revised to align the foundation works to TH3 with the second planned draining of GW#7.

7.8.9 The works area for TH3 and its associated footpath will occupy approximately 1,335m^2, which it is assumed will be temporarily cleared ground during the 2021 wet season. As with drain-down, temporarily cleared ground constitutes a normal element of the routine pond and gei wai desilting programme and hence does not constitute an additional impact due to the Project.

Boardwalks (Main Footpath and Access to TH1)

7.8.10 All works will be kept within the upper (dry) portions of the bund and no drain-down of pond/gei wai or works in wetland areas will be required.

7.8.11 The works area for construction will comprise approximately 0.31ha/3,100m^2 (additional to the footpaths), of which approximately 0.25ha/2,500m^2 will consist of gei wai bund and 0.06ha/600m^2 will consist of rain-fed pond bund. These areas would not normally be affected by desilting operations; hence this temporary impact is considered additional to that which would occur during routine management operations. However, the temporary loss of this small area of habitat, which is routinely disturbed by humans, is not considered to be of significance, especially since the phasing of construction will limit the works area to a maximum of 0.0465ha/465m^2 at any one time. Direct temporary loss of brackish gei wai (bunds) and rain-fed ponds (bunds) is shown in ***Table 7-34***, below.

Table 7-34 Direct Temporary Loss of Brackish Gei Wai Bund and Rain-fed Ponds Bund

CRITERIA	BRACKISH GEI WAI & RAIN-FED POND
Habitat Quality	Brackish gei wai and rain-fed ponds are both of very high ecological value. However, the bunds along the main footpath and leading to TH1 are of much lower value as they are heavily disturbed by human activities.
Species	Whilst gei wai and rain-fed pond habitats have a high diversity of waterbirds including many species of conservation importance, species diversity, especially that of waterbirds, using the bunds to be impacted is low to moderate due to the small areas and routine disturbance by human activities. Diversity of other fauna is low.
Size/Abundance	The area to be lost (approximately 0.31ha/3,100m^2 of bund) is small, both in absolute terms and relative to the area of these habitats within MPNR. The number of individuals of flora and fauna which will be impacted is correspondingly small.
Duration	2.5 months at most, but the maximum works area at any one time will be 0.0465ha/465m^2.
Reversibility	Fully reversible in a short time as vegetation is re-established.
Magnitude	Magnitude will be low as only a very small area (approximately 0.31ha of bund, 0.15% of these habitats) will be temporarily lost and only 0.05ha will be affected at any one time.
Impact Severity	Impact would be of **Low Severity** in view of the short duration and very small areas involved and existing high levels of disturbance.

Construction and Operational Phase Disturbance Impacts

Overview

7.8.12 Disturbance occurs when activities within a development site result in a reduction of the value of a habitat outside the site, usually because of fauna being deterred from using the habitat. Examples of disturbance include noise disturbance (which can scare certain species away from suitable habitat), visual disturbance from the presence of humans or vehicles within the site or in surrounding areas, or disturbance to nocturnal species or species roosting in the area at night from lighting resulting in glare to surrounding habitats. Disturbance may occur during construction and/or operation, and the nature and severity of the impact may differ at these times.

7.8.13 The severity of disturbance varies considerably depending on species (generally, larger birds and mammals are more disturbance-sensitive, smaller birds and mammals and other vertebrates are less sensitive, whilst most invertebrates are not sensitive) and activity (breeding individuals are often more prone to disturbance). In practice, for purposes of assessment, the most disturbance-sensitive impacts on larger birds and mammals can be used as a proxy for identification of most disturbance impacts. Open habitats, such as open water area in gei wai and rain-fed ponds and fishponds, provide less screening to sources of disturbance, and species living in such habitats are therefore usually more sensitive to disturbance impacts. Woodland, on the other hand, provides screening to the source of disturbance, and species using woodlands are often less concerned by the presence of human activity nearby. Wetlands such as mangroves, marshes and reedbeds that support dense vegetation, are particularly effective in providing cover for disturbance-sensitive species or disturbance-sensitive activity.

7.8.14 At its most severe, disturbance might result in a species entirely vacating a habitat. More often, however, it results in species occurring in lower numbers or less regularly. In many cases there will be an exclusion zone close to the source of disturbance, surrounded by a zone of reduced density where disturbance gradually drops until the disturbance has no impact on the species. The extent of exclusion zones and zones of reduced density are affected by several factors. Perhaps the most important is that disturbance-sensitivity varies greatly between species. Also very important is the degree of habituation to human activities – individual mammals and birds quickly learn if a location, such as a city park or nature reserve, is largely safe from frequent human interference. However, a number of other factors may be important, including the

presence of screening (whether intrinsic to the site or deliberately provided), the attractiveness of a site to a species (for example, species may tolerate more disturbance at a valuable food source), numbers of individuals present (large groups tend to be more sensitive than small numbers), and interspecific relationships (in mixed flocks of birds, less disturbance-sensitive species tend to be more sensitive than usual if more sensitive species are present).

7.8.15 Whilst some of the above factors are specific to particular location and circumstances, the two principal factors, species-specific sensitivity to disturbance and habituation, can be predicted with sufficient confidence to allow a quantitative assessment of potential impacts on species arising from project disturbance. ***Table 7-35***, below, details the evaluation of disturbance sensitivity of bird species found in MPNR and the Assessment Area and provides estimated distances for the exclusion zone and the zone of reduced density in respect to low-rise development. These are based on previous EIA reports for large-scale development projects in the Deep Bay area and are, thus, precautionary assessments of potential disturbance impact in respect of the small-scale development that the elements of this project constitute. The table also provides estimates for those species for which sensitivity to disturbance has not previously been assessed in the area based on field experience and knowledge of species' ecologies.

7.8.16 ***Table 7-35*** is based on the disturbance distance estimate methodology originally generated to assess disturbance impacts of the construction and operation phases of the Lok Ma Chau Spur Line (Binnie, Black & Veatch 2002) and the operation phase of the Fung Lok Wai private development (CH2M Hill 2008). The small scale of this Project means it would be inappropriate to use the distances for the construction phase of the Fung Lok Wai project, which comprises multi-storey residences immediately adjacent to fishponds. Similarly, the scale of the LMC Station and Spur Line far exceeds that of the project elements proposed under this study; thus, the use of operational phase disturbance predictions from that study is very conservative indeed and provides a large degree of tolerance.

7.8.17 For species not assessed during those studies, disturbance distance estimates have been generated using similar methodology. Such species are identified except where they are within the same genus and with similar ecological characteristics to species assessed under those studies. This approach has not been followed for ducks in recognition that Eurasian Teal, which was assessed under Binnie, Black & Veatch (2002), is less sensitive to disturbance than several larger species in the same genus *Anas*. Distances generated by Binnie, Black & Veatch (2002) assumed the implementation of screen planting, but no other *in situ* mitigation; application of these distances to impacts from the current development project is broadly comparable in this respect, subject to the assumption that hoardings are in place around any works area.

7.8.18 Regarding disturbance to species, within the exclusion zone it is assumed that all individuals are disturbed and displaced. Meanwhile, within the zone of reduced density, as disturbance is considered to decline progressively from complete exclusion to no impact; it is estimated that half of the individuals potentially present in the zone are disturbed.

7.8.19 In respect to ecological impact evaluation, exclusion zones and zones of reduced density apply to habitats and areas that are predicted to be newly disturbed or where there is a qualitative or quantitative increase in disturbance as a consequence of the project being assessed, i.e., the baseline assessment of habitat value takes into account existing disturbance levels. In the case of the present project, the existing concrete footpath is a 'disturbed area' from which disturbance-sensitive species are already excluded (the 'Exclusion Zone') and around which numbers of disturbance-sensitive species are already reduced (the 'Zone of reduced Density').

7.8.20 Based on this table, the most disturbance-sensitive species, Greater Spotted and Eastern Imperial Eagles, are estimated to have an exclusion zone of 0 to 200m and a zone of reduced density of 200 to 500m from construction sites and low-rise operational buildings (the disturbance source); whilst most larger waterbirds (larger ducks, spoonbills and larger ardeids) have an exclusion zone of 0 to 100m and a zone of reduced density of 100 to 200m.

Table 7-35 Predicted Distances at Which Regularly Occurring Waterbird or Wetland-associated Bird Species of Conservation Importance are Predicted to be Affected by Disturbance Impacts During Construction Phase and Operation Phase

SPECIES	EXCLUSION DISTANCE (m)	MAX DISTANCE OF REDUCED DENSITY (m)	SENSITIVITY TO DISTURBANCE
Larger Duck (*Anas* and *Aythya*) spp.*	100	200	High
Eurasian Teal, Garganey*	50	100	Moderate-High
Little Grebe*@	20	50	Moderate
Spoonbills*	100	200	High
Eurasian Bittern*	100	200	High
Yellow Bittern, Striated Heron*	20	30	Low
Chinese Pond Heron	20	30	Low – Moderate
Black-crowned Night Heron	20	30	Low
Eastern Cattle Egret*	20	30	Low – Moderate
Grey Heron	100	200	High
Purple Heron*	100	200	High
Great Egret	100	200	High
Intermediate Egret	100	200	High
Little Egret	20	100	Moderate – High
Great Cormorant	100	150	High
Eagles/Large Raptors*	200	500	Very High
Black Kite/Small & Medium Raptors*	20	30	Low
Western Osprey*@	100	200	Moderate
Black-winged Stilt	50	50	Moderate
Pied Avocet*	50	50	Moderate
Little Ringed Plover1=*	50	50	Low – Moderate
Med-large waders *	50	50	Moderate
Small Waders *	50	50	Moderate
Black-headed Gull*	50	50	Moderate
Larger kingfishers*	20	30	Low
Collared Crow*	50	100	Moderate
Small Reedbed/Marsh Passerines*	20	20	Low
Other small/med. Passerines*	20	100	Moderate

Notes: *: distances have been generated for this Study using similar methodology.
#: distances are greater than those used in CH2M Hill (2008).
@: the distances used in previous studies have been re-assessed for this project and new estimates are provided.

7.8.21 There is caveat that applies in the case of Black-winged Stilt, 20 nests of which were present on the bund between ponds 7 and 8 in 2021. Given that this bund provides construction access to TH3, there would be a significant impact if they again bred here in 2022.

Construction Phase

7.8.22 As noted above, to minimise potential construction phase disturbance impacts arising from the project it is proposed to avoid all external (outside) works during the dry season (mid-October to mid-April). This avoids the period when most large waterbirds are present in Deep Bay. It avoids the entire period when some of the most disturbance-sensitive species are present, notably Eastern Imperial and Greater Spotted Eagles and Great Cormorant (entirely absent) and Black-faced Spoonbill, Grey Heron and ducks (largely absent). This leaves a suite of small to medium wetland-dependent species and the large ardeids Great Egret and Purple Heron subject to potential disturbance impacts from construction and construction access. The most sensitive of these are the two species of large ardeid.

7.8.23 As the new footpath is being built in three phases, it is predicted that construction phase disturbance will not exceed that arising from pre-construction operation of the existing footpath. Potential disturbance impacts must be considered in respect of construction of the new TH2 and new TH3 and the access path for TH2, where these introduce disturbance to areas in rain-fed ponds and gei wai within MPNR that are not currently disturbed.

7.8.24 Regarding construction access, as the scale of works is relatively small and will involve, as much as possible, prefabrication off site, the amount of material to be transported is not large. The worst-case assumption of the increased number of heavy vehicles along Haul Road (HR) 2 is one vehicle per hour, while that along the Boundary Fence Road is between one and three (see ***Figure 4-4***), neither of which are considered to impose a significant additional impact. In addition, although the HR2 access track to MPEC is adjacent to GW16/17 (***Figure 2-2***), which serves as a high tide roost for migratory shorebirds, there is a raised mud bund between the track and GW16/17 that screens vehicles from roosting birds. There is one exception to this, however, and that relates to the use of area around P20 by Collared Crows as a pre-roost site.

7.8.25 Consequently, with the exception of the Collared Crow pre-roost sites, the use of the paved Boundary Road and the access track to MPEC by construction vehicles is not considered to constitute either a quantitatively or qualitatively different source of disturbance to that existing at present, as the number of vehicles will not be materially different to the present situation as these roads are regularly used by MPNR vehicles transporting materials and equipment, as well as police and AFCD vehicles.

7.8.26 In addition, the speeds at which trucks can drive will naturally be limited by the terrain of bunds between ponds (HR1 between ponds 20 and 21, HR2 and HR3 between GW7 and GW8); along the narrow boundary road, the speed of trucks is highly unlikely to be greater than the smaller vehicles currently using it. In any event, the speed of construction vehicles will be limited to 20km/h to minimise noise and dust generation.

7.8.27 Construction access to the new TH3, which will use HR3, a track that is not routinely used by vehicles, is not expected to result in disturbance or open water microhabitat loss additional to that caused by the desilting works in GW7. The non-open water microhabitats in GW7 are mangrove and emergent vegetation. However, the areas of both are relatively small and fragmented; furthermore, the timing of the works in the wet season (last week of April, first half of May, September and first half of October) means that bird species of conservation importance are relatively low in number. For these reasons, the significance of impact on GW7 is assessed as low.

7.8.28 GW8 will also be subject to routine management works during the construction period, and for the same reasons the potential for disturbance impacts on large waterbirds is very low. The brackish part of GW8 is largely occupied by reed marsh, a closed habitat in which fauna are much less disturbance-sensitive than open habitats. For these reasons, the impact of disturbance on most fauna using these habitats is considered low.

7.8.29 Construction access for TH2 along that section of HR1 between ponds 20 and 21 will also introduce disturbance to a largely undisturbed area. However, as noted above, as the scale of works is relatively small and as much as possible will be prefabricated off-site, the amount of material to be transported is not large. The worst-case assumption of the increased number of heavy vehicles along this section of HR1 is one vehicle per hour. The wet season nature of the works will reduce the scope and magnitude of impact considerably, but there is the potential for disturbance impacts on small numbers of foraging waterbirds in pond 21, as this has an open aspect and low water levels. Regarding pond 23, the adjacent areas are occupied by reed marsh, and the potential for disturbance is much lower due to the closed nature of this habitat. In addition, Collared Crows roost and gather at pre-roost in this area, including on a tree along the bund between ponds 20 and 21. The potential for impacts on these species is dealt with below.

7.8.30 Black-winged Stilts nest on recently-cleared ground largely or entirely devoid of vegetation. Given that as of 20 July 2021 there was already significant grass growth along the P7/8 bund that makes it unsuitable for nesting by this species, it is not predicted that this species will breed here again in 2022, when the growth will be denser. Consequently, no impacts are predicted.

Operation Phase

7.8.31 Significant disturbance impacts are not predicted to occur during operation of the Tower Hides as their design and management is specifically intended to allow visitors to be close to disturbance-sensitive species with minimum impact. They will be of a sober, olive-green colour and have narrow openings to keep those inside largely hidden in order minimise the visual impact on the habitat. Disturbance from the increased number of visitor groups in MPNR is predicted to be lower due to a smaller number of visitor hours. Human presence in MPNR will be less concentrated along the main footpath, MPEC and TH1 because TH2 and TH3 will also be available to absorb visitors over a larger area of MPNR.

7.8.32 The operation of TH2 introduces to that part of MPNR a higher amount of foot traffic, primarily from a small number of birdwatchers and researchers wishing to use the hide. However, those using the hide will need an annual permit based on a demonstrated commitment to birdwatching or other interests, and it is reasonable to assume that they will behave in a manner that minimises disturbance. Furthermore, appropriate screening of the access paths to both TH2 and TH3 in the form of bamboo or shrub planting will minimise disturbance impacts on adjacent areas. For these reasons, it is predicted that there would not be significant impacts arising from this source.

7.8.33 The habitats and areas potentially subject to disturbance impacts arising from construction and operation phases of the Project are detailed in ***Table 7-36***. These areas have been calculated based on their being regularly utilised at present by the most disturbance-sensitive species within the area potentially impacted by TH2 and TH3. (Great Egret and Purple Heron). No increase in disturbance from visitors is anticipated in the wet season, as described in ***Section 2.3***.

Table 7-36 Habitats and Areas Potentially Subject to Disturbance Impacts Arising from Construction and Operation of the Project in respect of birds

	CONSTRUCTION PHASE (HA)		OPERATIONAL PHASE (HA)	
HABITAT	WET SEASON	DRY SEASON	WET SEASON	DRY SEASON
TH2 AND ACCESS TRACK				
Brackish Gei Wai	3.3 (6.8)	0	0	0
Rain-fed Pond	3.4 (5.9)	0	0	0
TH3 AND ACCESS TRACK				
Brackish Gei Wai	1.9 (3.4)	0	0	0
Rain-fed Pond	1.8 (3.5)	0	0	0

HABITAT	CONSTRUCTION PHASE (HA)		OPERATIONAL PHASE (HA)	
	WET SEASON	DRY SEASON	WET SEASON	DRY SEASON
ALL PROJECT ELEMENTS				
Brackish Gei Wai	5.2 (10.2)	0	0	0
Rain-fed Pond	5.2 (9.4)	0	0	0

Note: Zones of Reduced Density are shown (in parentheses).

7.8.34 Potential disturbance impacts of significance, which are confined to the construction phase, on habitats in the absence of mitigation measures are detailed in ***Table 7-37***.

Table 7-37 Disturbance Impacts on Brackish Gei Wai and Rain-fed Pond Habitats

CRITERIA	ASSESSMENT
Habitat Quality	Both habitats are of Very High ecological value. Microhabitats potentially impacted are reed marsh, open water and terrestrial vegetation.
Species	Low to moderate numbers and diversity of birds, including some species of conservation importance, are present during the wet season. Diversity of other fauna is moderate and includes Eurasian Otter, a mammal species of high conservation importance that is sensitive to disturbance.
Size/Abundance	Both the potential exclusion zones and zones of reduced density are moderate in size (up to 10.4ha and 19.6ha respectively) relative to the areas of these habitats in MPNR. Number of waterbirds of conservation importance present during the wet season is low. Numbers of Eurasian Otters are uncertain but likely to be very small.
Duration	Disturbance from Tower Hide construction will be restricted to a period of 2.5 months in the wet season.
Reversibility	Removal of boardwalks and structures would be easy to accomplish in principle but is unlikely in practice. However, disturbance from human activity could be quickly reversed by preventing access.
Magnitude	Magnitude of potential disturbance arising from construction of TH2 and TH3 is considered low due to small numbers of waterbirds present.
Impact Severity	Impact would be of **Low Severity** in respect to hide construction as works will be confined to the wet season. During the operational phase of the Tower Hides, magnitude of disturbance would be of **Low Severity** throughout the year as hides are designed to avoid disturbance to wildlife.

Impacts on Fauna of Conservation Importance

Non-flying Mammals

7.8.35 Of the terrestrial mammal species of conservation importance recorded within the Project Site, Eurasian Otter, which is present in the Deep Bay area at a low density and is listed as Near Threatened by IUCN and as Endangered in the Red List of China's Vertebrates (2016), is of the highest significance.

7.8.36 Eurasian Otter and other mammal species present in MPNR are shy and largely nocturnal, except for Small Asian Mongoose which is frequently seen in the daytime. It is clear from work such as that carried out by McMillan et al. (2019) that otters are adaptable and can live in reasonable proximity to human activity if foraging and resting habitat remains and there is no frequent intrusion into areas of activity by humans or dogs. Given this and their largely nocturnal behaviour, it is not considered that the small-scale and diurnal nature of this project would necessarily lead to unacceptable disturbance. Diurnal disturbance would only occur if the project elements commenced in an area where there already exists an otter holt or natal den.

7.8.37 As footpath assembly is occurring in three phases to minimise disturbance impacts, adverse impacts of this element are predicted to be similar in magnitude to those occurring already in the pre-construction operational phase when the whole footpath is being used, and thus no

marginal impact is predicted. Disturbance impacts from the increased number of visitors in the post-construction operational phase are predicted to be lower due to a smaller number of visitor hours.

7.8.38 Disturbance impacts during creation of the tower hides are predicted to be of low magnitude due to the fact the process involves diurnal assembly of prefabricated units over a relatively short period of time (2.5 months). Furthermore, WWF camera trap data acquired in 2019 recorded otters only at pond 16B, which is not close to the proposed tower hide locations (minimum 600m distant from the nearest, TH2). Based on this, they are unlikely to be affected by the Project as there will be no loss of habitat or significant increase in human activity (construction works or visitor movements) in the areas or the times they are active.

7.8.39 Small Asian Mongoose may be deterred from daytime use of works areas, but avoidance of such a small area of potential habitat is not considered to be of significance for a species that is common in Hong Kong.

7.8.40 Accordingly, no significant direct or indirect adverse impacts on terrestrial mammals are predicted. However, on a precautionary basis, pre-construction checks for evidence of activity by mammals, in particular otters, of the footprint and adjacent areas of project elements are advisable. In this regard, camera traps were set up in December 2020 at or in the immediate vicinity of the proposed TH2 and TH3.

Table 7-38 Potential Disturbance Impacts on Non-flying Mammals

CRITERIA	ASSESSMENT
Habitat Quality	Wetland habitat in the Project Site and Assessment Area is of high value for mammals, some of which are of conservation importance.
Species	Of most significance is Eurasian Otter, which is of high ecological value and of which the Deep Bay area supports a regionally important population. Leopard Cat and Small Indian Civet are of conservation importance in a China context, but both are widespread in HK.
Size/Abundance	Habitat lost through conversion to developed area is very small and constitutes bund habitat and is not likely to impact mammals significantly. However, disturbance could be an issue regarding certain species. Numbers of animals impacted would be low, however.
Duration	Impacts of direct habitat loss would be permanent but insignificant; disturbance impacts due to tower hide construction would be confined to 2.5 months of the wet season construction phase of the Project (last week of April, first half of May, September and first half of October).
Reversibility	Removal of boardwalks and structures would be easy to accomplish in principle but is unlikely in practice. However, disturbance from human activity could be quickly reversed by preventing access.
Magnitude	No operation phase impact, while scope of diurnal disturbance impacts on nocturnally active fauna likely to be low. Should mammals use areas near the tower hide or access path locations, this may cause some disturbance.
Impact Severity	Impact would be of **Low Severity** on all species during the operation phases (hides are designed to avoid disturbance to wildlife). Diurnal construction activity could potentially impose disturbance impacts on mammals if they have established a resting or breeding area. For species other than Eurasian Otter, the impact this would be of **Low Severity**. Regarding Eurasian Otter, which is of regional conservation importance and high ecological value, construction activity would beof **Moderate Severity** if a natal den or holt was established at or near the hide footprint, but of **Low Severity** otherwise.

Bats

7.8.41 Bats are generally insensitive to disturbance while they are active (at night). However, they are potentially vulnerable at their roosts, especially at maternity/nursery roosts where females with

dependent young are present. As detailed in ***Appendix C2-1*** and ***Table 7-14***, a total of eleven bat species have been recorded in MPNR since 2015, in addition, two bat roosts were found during the surveys conducted for this Project. Based on findings of the 12-month survey in 2017, apart from two AFCD bat boxes (M103a and M105a), which were occupied by ant nests and not used by bats, all the other bat boxes, as well as the two bat roosts at the Chinese Fan Palm near Pond 182 and the green hut next to the MPEC, were used by bats in different months of the year. The MPEC is also used as an occasional roosting site by bats in low numbers. The roosts at bat box 407g, Chinese Fan Palm trees and the green hut consisted of adults and juveniles; therefore, it is very likely that these are maternity roosts.

7.8.42 Neither bat roosts nor bat boxes are present in the vicinity of TH2 or TH3. AFCD bat box M102 lies above a section of the footpath to be upgraded. However, given the relatively small scale of the works, it is not anticipated that these will pose significant disturbance to roosting bats, which are relatively tolerant of activity in the vicinity of bat boxes.

7.8.43 All bat species are protected by law in Hong Kong. Accordingly, prior to any tree pruning or felling works, a careful check should be conducted by an experienced ecologist to ensure that bats are not present.

Table 7-39 Potential Disturbance Impacts on Bats

CRITERIA	ASSESSMENT
Habitat Quality	Wetland habitat in the Project Site and Assessment Area is of moderate value for bats, though none of the species recorded appears to be wetland-dependent.
Species	Most species recorded are of medium conservation value, with one (Greater Bent-winged Bat) of High conservation value.
Size/Abundance	Habitat lost through conversion to developed area is very small and constitutes bund habitat that is of negligible significance to bats. However, disturbance could be an issue regarding certain species. Numbers of animals impacted would be low, however.
Duration	Impacts of direct habitat loss would be permanent but insignificant; disturbance impacts due to tower hide construction would be confined to 2.5 months of the wet season construction phase of the Project (last week of April, first half of May, September and first half of October).
Reversibility	Removal of boardwalks and structures would be easy to accomplish in principle but is unlikely in practice. However, disturbance from human activity could be quickly reversed by preventing access.
Magnitude	No operation phase impact, while scope of diurnal disturbance impacts on nocturnally active fauna will be low.
Impact Severity	Impact would be of **Low Severity** on all bat species during the construction and operation phases.

Birds

Potential Impacts on Bird Species of Conservation Importance

7.8.44 Many bird species of conservation importance occur regularly in the Project Site and the Assessment Area in significant numbers. On and off-site impacts on these species will take place if they are displaced due to the direct habitat loss arising from Project and/or displaced due to disturbance arising from construction of the new footpath, TH3 and TH2. As noted above, as construction will occur in the wet season (last week of April, first half of May, September and first half of October) the potential scope of adverse impacts is reduced considerably.

7.8.45 No significant disturbance impact is predicted from construction of new footpaths as there will be no significant increase in disturbance in the area. Similarly, no significant disturbance impacts are predicted from operation of the new TH3 and TH2 as these facilities will be designed with the explicit objective of permitting visitors to observe wildlife without causing disturbance.

7.8.46 An assessment of potential disturbance impacts on bird species of conservation importance is provided in ***Table 7-40***.

Table 7-40 Potential Disturbance Impacts on Bird Species of Conservation Importance

CRITERIA	BIRDS OF CONSERVATION IMPORTANCE
Habitat Quality	Wetland habitat in the Project Site and Assessment Area is of high to very high value for waterbirds of conservation importance.
Species	High numbers and diversity of birds, in particular waterbirds of conservation importance, are present during the dry season; moderate numbers and diversity of birds, but still including species of conservation importance, are present during the wet season. The suite of waterbirds at MPNR is of high ecological value.
Size/Abundance	Habitat lost through conversion to developed area is very small and all constitutes bund habitat, which is very little used by waterbirds. The potential exclusion zones and zones of reduced density due to disturbance are moderate (10.4ha and 19.6ha, respectively) and support large numbers of waterbirds of conservation importance during the dry season. Numbers of such waterbirds present in these areas during the wet season are low however, and disturbance-induced loss of wetland function is considered negligible.
Duration	Impacts of direct habitat loss would be permanent but insignificant; disturbance impacts due to tower hide construction would be confined to the wet season construction phase of the Project.
Reversibility	Removal of boardwalks and structures would be easy to accomplish in principle but is unlikely in practice. However, disturbance from human activity could be quickly reversed by preventing access.
Magnitude	Low construction phase impact as works will be conducted during wet season.
Impact Severity	Impact would be of **Low Severity** during the wet season in both construction and operation phases (hides are designed to avoid disturbance to wildlife and number of visitor hours will be lower).

Potential Impacts on Breeding and Roosting Ardeids

7.8.47 Several egretries are present in the vicinity of MPNR, and some of the birds breeding at these could use MPNR as a foraging area; data from the relevant egretries is presented in ***Table 7-1***. To determine the potential disturbance impact of the works on the egretries, ***Table 7-41*** presents the number of large waterbirds recorded in ponds adjacent to the works in the wet season months of May to October 2020. HR3 passes between ponds 7 and 8, while HR1 includes bunds between ponds 20 and 21 and between 20 and 23. As noted above, Pond 7 will be drained as part of routine management activities ahead of construction and is excluded.

Table 7-41 Numbers of Large Waterbirds Recorded in Selected Ponds During Wet Season 2020

POND NO.	MONTH	GREAT EGRET	PURPLE HERON	LITTLE EGRET	CATTLE EGRET	CHINESE POND HERON	TOTAL
8	April	25		71			96
	May	6		2			8
	June	2				2	4
	July	6		5		1	12
	August	2		1		1	4
	September	1	1	5		5	12
	October			1		5	6

POND NO.	MONTH	GREAT EGRET	PURPLE HERON	LITTLE EGRET	CATTLE EGRET	CHINESE POND HERON	TOTAL
19	April	1					1
	May	1		1			2
	June						0
	July						0
	August	2				2	4
	September		1			2	3
	October					1	1
20	April			1			1
	May						0
	June						0
	July	1		1	1		3
	August						0
	September						0
	October						0
21	April	9		2			11
	May	19		1			20
	June	2					2
	July	4		1			5
	August	2					2
	September	3					3
	October	1					1
23	April						0
	May	1		1			2
	June	8					8
	July						0
	August	4		1			5
	September						0
	October	1		1			2

7.8.48 The sum of large waterbirds recorded at individual ponds during the wet season surveys varied from zero to 20 plus one count of 96. Highest numbers were recorded at Ponds 8 and 21. A total of 142 ardeids were recorded in pond 8, and this relatively high figure was due to low water levels during the period because of management work in pond 8 in relation to the reedbed and the water channels. The dominant species were Great Egret (42), Little Egret (85) and Chinese Pond Heron (14), the three most abundant ardeids in Hong Kong in the wet season.

7.8.49 A total of 44 birds were recorded in pond 21, of which 33 were Great Egrets, 19 of which were present in May. Nine Great Egrets were present in April, but otherwise between one and four birds were recorded during the year. It is likely that the higher numbers of Great Egret in April and May refer to passage migrants, and not locally wintering or breeding birds. However, ponds or gei wai in the process of being drained down could attract large numbers of waterbirds to forage, and this needs to be borne in mind.

7.8.50 As can be seen from ***Table 7-1***, the total number of nests of Great Egret, Little Egret and Chinese Pond Heron in the potential foraging range of MPNR in 2020 was 1169 (i.e. 2338 adult birds), which included 670 nests (1340 individuals) of Great Egret, the most numerous species recorded

in the relevant ponds at MPNR. Thus, the potential magnitude and significance of impact of the Project on birds using these sites in terms of the overall Deep Bay population is predicted to be very low.

7.8.51 The only other species of potential concern in this habitat in the wet season is Purple Heron, which is primarily a passage migrant in low numbers and a winter visitor to HK, and thus is potentially an issue in May and August to October. Transect surveys are less than fully effective at recording a species such as Purple Heron, which occupies densely vegetated areas; observations by the surveyors at other times, however, have recorded up to six separate Purple Herons in MPNR. However, these are still low densities, which is to be expected for a large generally solitary species. Thus, the potential impacts on this species during the construction phase are also considered low.

7.8.52 In regard to roosting ardeids, the larger night roost near the site of the former PSFSC is approx. 280m from the nearest point of the Project Elements, and there is thus considered to be no impact on this. In regard to the pre-roost and roost sites identified on the reserve next to GW 8a, 10 and 15a, given the close proximity of a section of the footpath, construction works should cease one hour before sunset. By doing this, potential impacts on birds using both the Deep Bay-Shenzhen night roost and the pre-roost next to GW 8a and 10 will be avoided. ***Table 7-42*** shows the potential disturbance impacts on roosting and pre-roosting ardeids

Table 7-42 Potential Disturbance Impacts on Roosting and Pre-roosting Ardeids

CRITERIA	ROOSTING ARDEIDS
Habitat Quality	Roost and pre-roost sites are some ecological value due to their use by egrets, but such activity is often only temporary in response to foraging area location.
Species	Mainly Little Egrets and Chinese Pond Herons.
Size/Abundance	Roosts are generally small in size.
Duration	Uncertain, but could be long-term.
Reversibility	TH3 and footpath could be removed but this is unlikely in practice.
Magnitude	No operational phase impacts. However, construction of footpath TH3 could impose disturbance impacts.
Impact Severity	**Low to Moderate** during construction phase.

Potential Impacts on Collared Crow Roost Sites

7.8.53 Regarding Collared Crow, Stanton *et al*. (2014) and monitoring work by WWF indicates that pre-roost and roost sites are in the southwest quadrant of the reserve, and the nocturnal roost site is in the mangrove outside the boundary fence opposite pond 16-17. Data from roost surveys carried out by WWF in 2019-20 are presented in ***Table 7-6***. These indicate nocturnal roosts at Ponds 18/19 and 21 in the wet season, and Ponds 19W/20A and the mangrove outside the boundary fence in the dry season.

7.8.54 The proximity of the bund between P18 and P19, and Pond 21 to the location of TH2 and its construction access route suggests substantial impact could accrue because of disturbance from construction activities. Direct loss of roost site will not happen as no trees will be felled.

Table 7-43 Potential Disturbance Impacts on the Collared Crow Roost

CRITERIA	COLLARED CROW ROOST
Habitat Quality	Collared Crow roost site of high ecological value due to the presence of the roost.
Species	Collared Crow (Vulnerable in IUCN Red List), of ecological value.
Size/Abundance	Roost is large (up to 197 individuals in 2019) and of regional importance.
Duration	2.5 months during the wet season.
Reversibility	Hides could be removed but this is unlikely in practice.

CRITERIA	COLLARED CROW ROOST
Magnitude	Low construction and no operational phase impacts from construction/operation of TH3 and the footpath, and from operation of TH2. However, construction of TH2 could impose substantial disturbance impacts.
Impact Severity	**Moderate** during construction phase in relation to TH2.

Potential Impacts on Great Cormorants

7.8.55 In addition to exclusion or reduction in numbers due to disturbance, which may potentially affect all wetland bird species of conservation importance, particular consideration must be given to the Mai Po Great Cormorant roost, together with flight lines to and from the roost. As is shown in ***Table 7-16***, the MPNR Great Cormorant roost, one of three roosts in the Deep Bay area, held up to 32% of the Deep Bay wintering population in winter 2016-17.

7.8.56 Cormorants departing from the roost in 2016-17 took a variety of individual flight paths, with no evidence of any defined flight lines. However, cormorants leaving roost sites in January to March 2020 adopted two broad paths, as indicated in ***Figure 7-11***. One of these led directly from the roost between GW10 and GW11 out to the bay, while the second flew north, probably for the length of the reserve to the west of the Casuarinas, and thus over the location of TH3. The footprint of both tower hides is small, however, and they only reach three storeys in height; for these reasons, negligible impact on cormorant flight lines is anticipated during the operation phase.

7.8.57 The roost is occupied during the dry season only (October to April, with most birds present during November to March); thus, there is very limited scope for impacts during the wet season construction period on roosting cormorants or those using flight lines above MPNR. Furthermore, even for the very small number of birds present in the first half of October, as is shown in ***Figure 7-9***, the roost is not within the predicted exclusion zone or zone of reduced density for this species of 100m and 150m respectively arising from the proposed TH2 and TH3. As discussed above, in the operation phase there will be no significant increase in disturbance along the existing footpath because of the Project, as the number of visitor hours will decrease despite the number of visitors increasing. In addition, most visitors to the reserve have departed by the time the nocturnal roost assembles. Accordingly, no significant potential disturbance impacts would arise from the Project on the Great Cormorant roost in MPNR or flightlines to/from these.

7.8.58 Potential disturbance impacts on the cormorant roost and the associated flight lines are evaluated in ***Table 7-44***.

Table 7-44 Potential Disturbance Impacts on the Great Cormorant Roost and Flight Lines

CRITERIA	GREAT CORMORANT ROOST AND FLIGHT LINES
Habitat Quality	Cormorant roost tree habitat is of high ecological value due to the presence of the roost.
Species	Great Cormorant (PRC in Fellowes *et al*. (2002); the Deep Bay wintering population is of high ecological value.
Size/Abundance	Roost was large with up to 3177 individuals in 2016/17), though a maximum of only 855 birds were recorded in 2019-20; none is within the potential exclusion zone or the zone of reduced density.
Duration	No disturbance impacts are predicted from construction and operational use of TH2 and TH3 and no additional disturbance relative to the baseline is predicted for other project elements.
Reversibility	Hides could be removed but this is unlikely in practice.
Magnitude	No construction phase impact as works will be conducted during wet season; no operational phase impact as roost locations are outside the potential disturbance and exclusion zones and hides are designed to avoid disturbance to wildlife from users. Insignificant impact to flight lines given the small footprint and height of TH2 and TH3.
Impact Severity	**No** and **Very Low Impact** during construction and the operational phase of the project respectively.

Potential Impacts on Bird Flight Lines

7.8.59 A flight line is a route which is regularly followed for local movements of one or more individuals over a period (unlike a flight path, which is the route of a single individual on a single occasion, or a flyway, which is a broad route followed by many migrating individuals over a long distance). A common example relevant to Hong Kong is the flight line between an egretry and the foraging sites used by breeding egrets; birds will follow such a flight line regularly over the course of the day to collect food and then return to the nest to incubate or to feed young. Flight lines also regularly occur between foraging areas and roost sites, especially those of species that roost communally. Starting and finishing points of flight lines may be tightly defined (such as a roost site or a breeding site) or cover a wider area (for example a foraging area covering a wide area of habitat). Geographical features may influence the location of flight lines; for example waterbirds tend to follow water features such as rivers and may follow valleys even when a route crossing a line of hills would be shorter. An assessment of potential impacts is provded in ***Table 7-45***.

Table 7-45 Potential Disturbance Impacts on Bird Flight Lines (excluding Great Cormorants)

CRITERIA	BIRD FLIGHTLINES
Habitat Quality	MPNR is a high quality and relatively undisturbed habitat.
Species	Wetland dependent species and certain birds of prey, many of which are of high ecological value.
Size/Abundance	Large numbers of waterbirds occur in the non-breeding season from October to early May. Relatively low numbers of ardeids occur in the breeding season from March to August.
Duration	No disturbance impacts are predicted from construction and operational use of TH2 and TH3 for this group of birds, and no additional disturbance relative to the baseline is predicted for other project elements.
Reversibility	Hides could be removed but this is unlikely in practice.
Magnitude	Very low magnitude.
Impact Severity	**Low Impact** during both construction and operational phases of the project.

7.8.60 Development located on a flight line may result in a decrease in the suitability of a foraging, breeding or roosting site by preventing movement to another site or by reducing the efficiency of movement between sites. In an extreme case, this may lead to the total abandonment of one or both sites. There may also be an increased risk of mortality by collision with structures constructed on or close to a flight line.

7.8.61 The Project includes elements that involve construction works at ground level only (i.e. construction of new footpaths) and construction works up to three storeys (i.e. the two new tower hides). In the current case no significant flight line impacts are predicted, as the footprints of the tower hide works are so small there will not be a barrier effect, especially as there are wide open spaces above MPNR. In addition, for the same reasons project elements will not block or otherwise influence flight lines between egretries and foraging areas or between brackish water habitats and the Deep Bay mudflats, the latter being utilised by migrant shorebirds and wildfowl.

7.8.62 Dry season flight lines will be unaffected as construction will occur in the wet season.

Other Fauna

7.8.63 The loss of small areas of gei wai bund and pond bund will not reduce the habitat available to fauna other than birds and mammals; nor will the proposed works result in significant disturbance impacts as the proposed relatively small-scale works will not materially add to baseline disturbance impacts on these groups for which ongoing routine management measures are of far greater significance. Reptiles such as Burmese Python and other snakes have been noted utilising the existing concrete footpath, but the placement of a wooden walkway above this will ensure that uninterrupted passage remains, although it is possibly equally likely that such animals would go over rather than under.

7.8.64 Bent-winged Firefly (and other fireflies) are potentially sensitive to light disturbance (which may interfere with breeding activities that rely on visual signals). However, no new temporary or permanent lighting sources are proposed, hence, again, no impacts on fireflies are predicted.

7.8.65 An assessment of potential disturbance impacts on other fauna is provided in ***Table 7-46***.

Table 7-46 Potential Disturbance Impacts on Non-bird Non-mammalian Fauna

CRITERIA	NON-BIRD NON-MAMMAL FAUNA
Habitat Quality	MPNR is a high quality and relatively undisturbed habitat.
Species	Herpetofauna, dragonflies, butterflies all present though diversity is not particularly high. Mai Po Bent-winged Firefly occurs in areas abutting the reserve boundary. This area is far from the location of project elements however.
Size/Abundance	Numbers of non-bird fauna are not high.
Duration	No disturbance impacts are predicted from construction and operational use of TH2 or TH3 for this group, and no additional disturbance relative to the baseline is predicted for other project elements.
Reversibility	Hides could be removed but this is unlikely in practice.
Magnitude	Very low magnitude.
Impact Severity	**No Impact** during both construction and operational phases of the project.

Fragmentation Impacts

7.8.66 Fragmentation impacts arise where development or other human activities impede or sever ecological linkages between or within habitats and areas. Construction of a development between habitats which show ecological linkage may result in the loss of these links and thus a decrease in the suitability of the habitat for species and a reduction in the overall value of the habitat. The isolation of two patches of habitat can prevent the movement of organisms between these habitat patches, resulting in an effective reduction in population size and genetic isolation of the population.

7.8.67 Construction within a large, continuous habitat patch may result in an edge effect reducing the overall value of the habitat. Generally, larger areas of habitat are of higher importance than smaller areas; this is not simply an arithmetical relationship (for example doubling the area of a particular habitat may result in more than double the ecological value). Many species require a minimum area of a habitat and would not utilise two smaller fragments amounting to the same area. The severity of fragmentation impacts will depend upon the extent to which severance occurs (whether this is partial or total), the relative sizes of resulting fragments, the extent and complexity of previous linkages, the baseline species diversity and the mobility of the species concerned.

7.8.68 At its most extreme, fragmentation impacts may result in the loss of populations of a species if the remaining fragments are too small to support a viable population. Species most affected by fragmentation impacts are habitat specialists, terrestrial species and species with low mobility. Birds and flying insects are generally less affected than mammals, herpetofauna and non-flying invertebrates.

7.8.69 Evaluation of both types of fragmentation impact described above (i.e. severance of linkages between habitats and areas and the introduction of fragmentation within a continuous habitat area) has been undertaken. With regard to severance of linkages, it is considered that the construction of new footpaths will not materially affect linkages, as the main linkages of importance between the fishponds and habitats in MPNR are for birds and mammals. The former will not be deterred from flying over the footpaths, whilst mammals readily use the existing footpaths and boardwalks as movement corridors.

7.8.70 Similarly, most of the proposed project elements will not increase fragmentation within a continuous habitat: construction of the TH3 and construction of associated new boardwalks are

within already disturbed areas and the small scale of the proposed TH2 and associated footpath will not materially alter the character of the extensive area of gei wai in which it will be located.

7.8.71 An assessment of potential fragmentation impacts is provided in **Table 7-47**.

Table 7-47 Potential Fragmentation Impacts

CRITERIA	FRAGMENTATION IMPACTS
Habitat Quality	MPNR is a high quality and relatively undisturbed habitat.
Species	Of primary importance to a large suite of wetland dependent species, primarily birds; herpetofauna, dragonflies, butterflies all present though diversity is not high. Mai Po Bent-winged Firefly occurs in areas abutting the reserve boundary. This area is far from the location of project elements however.
Size/Abundance	Numbers of birds are high, numbers of non-bird fauna are not high.
Duration	No fragmentation impacts are predicted from construction and operational use of TH2 or TH3.
Reversibility	Hides could be removed but this is unlikely in practice.
Magnitude	Very low magnitude.
Impact Severity	**No Impact** during both construction and operational phases of the project.

Hydrological Disruption

7.8.72 Hydrological disruption may have significant impacts to wetland habitats, either by increasing or decreasing water inputs or changing water quality (changes in salinity, temperature, pH and suspended solids) – Such impacts have the potential to adversely affect fauna and flora. However, none of the project elements has the potential to result in hydrological disruption. Accordingly there are no predicted hydrological impacts of significance arising from the Project.

7.8.73 An assessment of potential impacts of hydrological disruption is provided in ***Table 7-48***.

Table 7-48 Potential Impacts of Hydrological Disruption

CRITERIA	FRAGMENTATION IMPACTS
Habitat Quality	MPNR is a high quality and relatively undisturbed habitat.
Species	Of primary importance to a large suite of wetland dependent species, primarily birds; herpetofauna, dragonflies, butterflies all present though diversity is not high. Mai Po Bent-winged Firefly occurs in areas abutting the reserve boundary. This area is far from the location of project elements however.
Size/Abundance	Numbers of birds are high, numbers of non-bird fauna are not high.
Duration	No hydrological impacts are predicted from construction and operational use of TH2 or TH3.
Reversibility	Hides could be removed but this is unlikely in practice.
Magnitude	Very low magnitude.
Impact Severity	**No Impact** during both construction and operational phases of the project.

Direct Mortality

7.8.74 Direct mortality involves the death of organisms because of the development, including individuals killed during the construction process or individuals killed from the structures constructed. Animals may be hit and killed or injured by rapidly-moving vehicles or by collision with stationary objects. Birds and mammals appear to be most susceptible (Van der Grift and Kuijsters 1998), though herpetofauna are also prone. Whilst the risk of animal mortality arising from road kill and collision with buildings is likely to be greater in rural areas than in already developed, urban areas, as wildlife populations are higher in the former, the nature and scale of the Project is such that mortality impacts from most sources and on most animals are not considered to be significant.

7.8.75 Nevertheless, the Project should seek to ensure that mortality to terrestrial fauna caused by construction vehicles is minimised by ensuring that drivers adhere to appropriate speed limits and safe driving practices (the latter being essential in any case due to road and site conditions). In addition, the speeds at which trucks can drive will naturally be limited by the terrain of bunds between ponds; along the narrow boundary road, the speed of trucks is highly unlikely to be greater than the smaller vehicles currently using it. Nonetheless, the speed of construction vehicles within the Project Site will be limited to 20km/h. Potential direct mortality impacts are evaluated in ***Table 7-49***.

Table 7-49 Potential Direct Mortality Impacts

CRITERIA	DIRECT MORTALITY
Habitat Quality	Not relevant.
Species	Mammals and herpetofauna during construction and (from collisions with traffic) during operation; birds during operation; all species, especially roosting/nesting animals during site clearance.
Size/Abundance	Areas where impacts could occur are relatively small in the context of the Assessment Area; numbers of terrestrial fauna are low, but bird numbers are large.
Duration	Death of terrestrial fauna from construction activities would only occur during the construction phase. Other impacts would be permanent.
Reversibility	Not reversible.
Magnitude	Number of individuals likely to be affected is small; hence magnitude of impact is low.
Impact Severity	**Low Severity** during construction so long as appropriate speed limits and safe driving practices are adhered to, and **Low Severity** during operation.

Cumulative Impacts

7.8.76 The demolition and rebuild of PSFSC near MPNR is scheduled to have been completed by March 2022 whereas the construction of this Project will commence in the final week of -April 2022, leaving a three-week buffer. As such, the rebuild of the PSFSC is not likely to be concurrent with this Project. There are also no other concurrent projects near MPNR. Thus, cumulative ecological impacts from this source for this Project are not anticipated. However, if the PSFSC project was to overrun more than three weeks, it is still predicted that there would be no significant cumulative impact at the distance of the PSFSC site is a minimum of 290m from the nearest Project Element and the scale of works at the PSFSC by that time will be small in nature and intrinsically of low impact. Furthermore, any concurrence will be in the wet season when the number of waterbirds at MPNR is substantially lower.

7.8.77 As shown in the Project Programme in ***Figure 2-6***, there are also no concurrent works related to the *MPNR Management Plan 2019-2024* and so no cumulative ecology impacts.

Other Impacts

7.8.78 Other potential types of impact include noise, glare and dust. The scope for these is not considered great due to the small scale of the project. The potential impacts of all will be minimised via the assembly of prefabricated units on site. The noise of vehicles will be additive to that currently occurring due to WWF, AFCD or Police vehicles driving along the boundary fence road, or that arising from management works along pond or gei wai bunds. However, given the wet season timing of construction, this is only likely to be of significance in the vicinity of Pond 20 and the pre-roost site of Collared Crow.Dust production is also likely to be relatively low due to the wet season nature of works. Regarding glare, which is strong or bright light that, in this case, causes disturbance, this is predicted to be negligible as no nocturnal (i.e. before sunrise or after sunset) activity will be carried out that produces excessive lighting.

7.8.79 Regarding run-off, as noted in Section 5, the creation of the boardwalk does not require excavation work and is some distance from water bodies, and so no muddy run-off is anticipated from this source. In regard to the tower hides, draining of gei wai according to the MPNR

Management Plan will provide hydraulic isolation that will avoid discharge into water-filled gei wai. In addition, the construction of perimeter bunds around the work sites for TH2 and TH3 will ensure that any discharge only reaches adjacent gei wai, and not other water-filled gei wai. Off-site prefabrication, off-site cement mixing and off-site maintenance/repair of plant will further reduce the potential for run-off impacts. Consequently, no impact is from this source is predicted.

Table 7-50 Other Impacts (Noise, Glare, Dust and Run-off)

CRITERIA	OTHER IMPACTS
Habitat Quality	MPNR is a high quality and relatively undisturbed habitat.
Species	Of primary importance to a large suite of wetland dependent species, primarily birds; herpetofauna, dragonflies, butterflies all present though diversity is not high. Mai Po Bent-winged Firefly occurs in areas abutting the reserve boundary. This area is far from the location of project elements however.
Size/Abundance	Numbers of birds are high; numbers of non-bird fauna are not high.
Duration	Noise impacts from construction vehicles will last for a maximum of 2.5 months. Other impacts not predicted.
Reversibility	Construction phase impacts arising from noise could be stopped at a point in time, but not reversed.
Magnitude	Number of individuals likely to be affected is small; hence magnitude of impact is low.
Impact Severity	**Moderate Severity** regarding noise impacts on Collared Crow pre-roost site, but other aspects of **Low Severity** during construction so long as appropriate speed limits and safe driving practices are adhered to, and none during operation.

7.9 Mitigation of Impacts

Introduction

7.9.1 Mitigation measures are required to ensure that the potential ecological impacts of significance described above are avoided, minimised or compensated (summarised in ***Table 7-51***, below). Avoidance and minimisation measures were described above in Section 7.8.3 and 7.8.4, as they were considered prior to assessing impact. This section describes the remaining impact, and the mitigation proposed to deal with these. In addition to impacts that require mitigation under the requirements of the EIAO, reference is also made to other measures that reflect the ecological sensitivity of the site.

7.9.2 The mitigation measures proposed follow the principles and guidelines laid out in Annex 16 of the EIAO-TM. All proposed mitigation measures are feasible to implement within the context of Hong Kong, will be undertaken on-site (i.e. within the Project Site). The applicant will consult relevant government departments, particularly AFCD, on the appropriate measures to avoid adverse impact to roosting or breeding species, should this become necessary.

Table 7-51 Potential Ecological Impacts Requiring Mitigation under EIAO.

POTENTIAL IMPACT	POTENTIAL SEVERITY
Direct permanent loss of brackish gei wai bund and rain-fed pond bund	Low to Moderate
Construction phase disturbance to mammal resting or breeding sites, in particular those of Eurasian Otter, from diurnal construction activity.	Moderate
Construction phase disturbance in vicinity of footpath and TH3 on ardeid roost and pre-roost sites.	Low to Moderate
Construction phase disturbance to roost or pre-roost sites of Collared Crow from diurnal construction activity in relation to TH2.	Moderate

Proposed Mitigation and Precautionary Measures

Measures to Avoid and Minimise Impact

7.9.3 The following measures will be adopted to avoid and/or minimise impacts.

- **External Construction Works During Wet Season Only**. The three project elements will be assembled/constructed over a two-month period between mid-April and mid-October, thus avoiding impacts on the high number of waterbirds and wetland-dependent species present in the dry season. This is, perhaps, the most significant of the impact avoidance measures.
- **Off-Site Prefabrication of Building Components**. To minimise impacts to ecologically sensitive areas, activities within MPNR will mainly concern assembly of prefabricated items.
- **Construction of New TH2**. The location of the new TH2 has been chosen primarily to enhance visitor experience by allowing more serious birdwatchers to view a section of the Reserve that has not previously been visible to visitors. The exact location has been chosen to avoid loss of wetland (gei wai) area, the need to avoid loss of existing trees, both arising from the construction of the hide itself and the access route, to allow researchers to survey the birds in the southern part of MPNR, and to minimise the requirement for new footpath for access.
- **Construction of New TH3**. The new TH3 will provide a new tower hide near the entrance of the MPNR for nature education particularly for families, students and those not disposed to long walks. As with TH2, the location has been chosen on an existing bund to avoid wetland loss and loss of existing trees.
- **Construction of Footpath**. The location of this Project element is fixed, as it is situated above the existing footpath. However, the proposed footpath has been designed to avoid intrusion into wetland areas (either gei wai or rain-fed ponds) and to avoid felling of existing trees. In addition, construction will be carried sequentially in three sections in order to minimise disturbance impacts.
- **Construction Access**. To avoid habitat loss impacts, construction access will occur along the existing Boundary Fence Road and via existing pond/gei wai bunds. Haul roads are shown on ***Figure 7-2***. Transport of construction materials will occur over a two-month period between mid-April and mid-October.
- **Tower Hide Design**. This will allow visitors to be close to disturbance-sensitive species with minimum impact.
- **Completion of pond draindown before commencing work**. In order to ensure that there are no disturbance impacts on birds attracted to ponds that are being drained down, construction will only commence once the pond is fully drained.

Potential Construction Phase Disturbance to Mammals, in Particular Eurasian Otter

7.9.4 As a precautionary measure, adequate site checks in the works area and in the vicinity of the footprint of all project elements will be conducted by a suitably qualified ecologist prior to commencement of works to search for substantive usage of the habitat by flora and/or fauna of conservation concern, e.g. the presence of an otter holt. If roosting or breeding species are found appropriate measures should be taken to avoid adverse impact, including adjustments to the timing of the works.

7.9.5 In addition, WWF has placed camera traps at both tower hide sites since January 2021 in order to monitor these areas for use by otters and other mammals. This precautionary measure will allow a better assessment of the frequency with which they use these areas and the nature of that use.

7.9.6 It is proposed to reduce the potential for disturbance impacts during the construction phase on species using adjacent habitats by installing a 2m-high solid, opaque screen around works areas. In addition, planting bamboo using the native species *Bambusa tuldoides* (青稈竹, 花眉竹) a minimum of 2m high and of sufficient depth to provide an effective screen will be provided along the access path to the new Tower Hides to reduce disturbance during the operational

phase. It may be necessary to install artificial screens in the early phase while the natural screen planting reaches acceptable height/depth.

Potential Construction Phase Disturbance to Collared Crow Roost and Pre-roost Sites

7.9.7 Stanton et al. (2014) noted that Collared Crows were often present at pre-roost sites before the start of their surveys, which began 60 minutes prior to sunset. Consequently, to avoid impacts on nocturnal roost sites and associated pre-roost gatherings of Collared Crow in the vicinity of Pond 20, all construction activity for TH2 and its associated access path, including the passage of construction vehicles, will cease two hours before sunset. This means 4pm in the wet season construction period.

Precautionary Measures to Address Potential Impacts on Breeding Ardeids

7.9.8 Ahead of construction, ET checks will be conducted during the breeding season to check for the presence of breeding ardeids within 500m of the footprint of project elements. These checks should be carried out two weeks prior to construction commencing and the day before. Should any egretry be discovered in the vicinity of works areas, the need for mitigation measures shall be assessed in consultation with AFCD.

7.9.9 To avoid disturbance to pre-roost and roost sites in the vicinity of the footpath and TH3, construction works associated with these elements will cease one hour before sunset.

Precautionary Measures to Address Potential Mortality Impacts

7.9.10 Whilst predicted potential direct mortality impacts are considered as of low severity, this evaluation is predicated on there being speed limits for construction vehicles and safe driving practices being followed. The contractor shall be instructed to inform its drivers of the importance of these measures.

7.9.11 Adequate site checks along haul roads and in the works area and in the immediate vicinity should be conducted prior to the commencement of works at TH2 and TH3 to detect substantive use of adjacent habitat by species of conservation concern. If roosts or breeding species are found, appropriate measures should be taken to avoid adverse impact, including adjustments to the timing of works.

7.9.12 All bird and bat species are protected by law in Hong Kong. Accordingly, prior to any tree pruning or felling works, a careful check should be conducted by an experienced ecologist to ensure that bats or active bird nests are not present.

Mitigation for Pollutant Runoff and Surface Runoff

7.9.13 Pollution of wetland areas, in particular any areas with a hydrological connection to the wider Deep Bay wetland ecosystem has the potential to be a significant adverse ecological impact. However, based on the water quality impact assessment in ***Chapter 5***, a number of measures will be put in place that will prevent contaminated run-off from works areas from entering surrounding gei wai, and from there potentially into Deep Bay. Mitigation measures are detailed in ***paragraphs 5.4.18 and 5.4.19***. With these measures in place, there is no credible potential for adverse ecological impacts to occur because of polluted run-off. No further mitigation is considered necessary from an ecological perspective.

Mitigation of Wetland Loss

7.9.14 As the new TH2 and TH3 and boardwalk path construction will cause a loss of very small areas of gei wai bund and pond bund, desilting channels at gei wai 19, reconnecting gei wai 19a with gei wai 19b, and merging the six sub-ponds (20a to 20f) of gei wai 20 in order to enhance the habitat there will be the measures to mitigate the potential wetland loss due to TH2. For the potential wetland loss related to TH3, it will be mitigated by enhancement of gei wai 8a through reprofiling and connection of gei wai 8a with gei wai 7.

7.10 Conclusions

7.10.1 The current ecological conditions and potential ecological impacts of the Project have been assessed. Based on this review, measures to avoid and minimise ecological impacts have been recommended. With these measures in place and having considered the relevant assessment criteria listed in the EIAO-TM (effects on health of biota, the magnitude, geographic extent, duration and frequency of adverse impacts, the likely community size affected, the degree to which the adverse impacts are irreversible, the ecological context, the international or regional importance of the species or habitats and both the likelihood and degree of uncertainty of adverse environmental impacts), it is considered that all significant ecological impacts from the Project will be addressed and there will be no unacceptable residual impacts. ***Table 7-52***, below, summarises the conclusions.

Table 7-52 Summary of Proposed Ecological Mitigation Measures Required to Address Predicted Significant Impacts and Predicted Residual Impacts

POTENTIAL IMPACT	SIGNIFICANCE OF POTENTIAL IMPACT	PROPOSED MITIGATION MEASURES	PREDICTED RESIDUAL IMPACT
DIRECT LOSS OF HABITATS (CONSTRUCTION & OPERATION PHASES)			
Direct Loss of Wetland Habitats due to Development	Loss of very small areas of gei wai bund and pond bund to Tower Hide and boardwalk path construction would be of **Low** significance in the construction phase and of **Low to Moderate** significance in the operation phase.	Habitat enhancement of adjacent Gei Wai/Rain-fed pond by desilting.	Residual impacts are of very low severity. No loss of wetland function as per TPB Guidance Note 12C.
DISTURBANCE IMPACTS (OPERATION PHASE)			
Disturbance Impacts on Wetland Habitats and associated fauna	Potential disturbance impacts on large waterbirds of **Low** significance as tower hides designed to allow close observation of disturbance-sensitive fauna. Number of visitor hours is lower, despite the number of visitors being higher.	Assumes use of 2m high bamboo screening along access paths to hides to minimise operational phase disturbance by visitors	Residual impacts are of very low severity. No loss of wetland function as per TPB PG-No. 12C.
DISTURBANCE IMPACTS (CONSTRUCTION PHASE)			
Disturbance Impacts on Wetland Habitats	Potential disturbance impacts on large waterbirds of **Low** significance as works will be undertaken during the wet season.	**Avoidance/Minimisation:** No construction works between 16 October to 15 April each year. 2m high solid and opaque site hoarding to screen some construction activities from adjacent areas.	Residual impacts are of very low severity.
IMPACTS ON FAUNA SPECIES OF CONSERVATION IMPORTANCE			
Non-flying Mammals	Indirect adverse disturbance impacts in both construction and operation phases **Low**, except in the case of Eurasian Otter for which it could be of **Moderate** significance in the construction phase.	**Pre-construction monitoring of the footprint and vicinity** of all project elements **should be carried out to identify any use by otters** or other mammals of conservation importance.	Residual impacts of Low Severity.
Bats	Given the relatively small scale of the works, it is not anticipated that these will pose significant disturbance to roosting bats, which are relatively tolerant of activity in the vicinity of bat boxes. Impact significance **Low** in both construction and operation phases.	Not required. However, as all bat species are protected by law in Hong Kong, prior to any tree pruning or felling works a careful check should be conducted by an experienced ecologist to ensure that bats are not present	No residual impact.
Roosting Great Cormorants	No impact is predicted during the construction phase as works will be conducted during the wet season and, Tower Hides are located away from roost sites. Operation phase impacts are predicted to be **Very Low**, and mitigation is not required.	**Avoidance/Minimisation**: No mitigation other than avoiding construction works between 16 October to 15 April each year.	No residual impact.

POTENTIAL IMPACT	SIGNIFICANCE OF POTENTIAL IMPACT	PROPOSED MITIGATION MEASURES	PREDICTED RESIDUAL IMPACT
IMPACTS ON FAUNA SPECIES OF CONSERVATION IMPORTANCE (CONT'D)			
Collared Crows	Construction phase disturbance to roost or pre-roost sites of Collared Crow from diurnal construction activity in relation to TH2 could be of **Moderate** significance.	All construction activity associated with TH2 and its access path, including the passage of construction vehicles, will cease two hours before sunset.	Residual impact of low severity.
Other Bird Species	Impact predicted to be of **Low** Severity during the wet season construction phase. During the operational phase of the Tower Hides, magnitude of disturbance would be of Low Severity throughout the year as hides are designed to avoid disturbance to wildlife.	**Avoidance/Minimisation:** No mitigation other than avoiding construction works between 16 October to 15 April each year and utilising 2m high bamboo screening along the access paths to the Tower Hides to minimise operational phase disturbance by visitors.	Residual impacts of Low Severity.
Bird flight lines	Flight line impacts of **Low** significance are predicted, since the footprint of each of the tower hides is so small and will not create a barrier effect.	No mitigation measures are required.	Residual impacts of Low Severity.
Ardeids breeding or roosting in MPNR and its vicinity	In absence of an egretry in MPNR, no significant impacts predicted. However, precautionary checks are required ahead of construction. The significance of the potential impact will depend on the distance from project elements, and could range from no impact to high. In regard night roosts, only the pre-roost next to GW 8a and GW 10 and the roost in GW 15a could potentially be impacted during the construction phase.	Checks to ensure that no egretry has established within 500m of the footprint of project elements. These checks should be carried out two weeks prior to construction commencing and the day before. If an egretry has developed, appropriate mitigation measures should be implemented after consultation with AFCD. Construction activities in relation to TH3 and the footpath should cease one hour before sunset.	In absence of egretry, no residual impacts.
Other Fauna and Flora	No significant impacts are predicted.	No mitigation measures are required. On a precautionary basis however, pre-construction monitoring of the the footprint and vicinity of all project elements should be carried out to identify use or presence of species of conservation importance.	No residual impacts.
Fragmentation Impacts	No impacts predicted.	No mitigation measures are required.	No residual impacts.
HYDROLOGICAL DISRUPTION			
Hydrological Disruption to Wetland Habitats	Project elements have no potential to cause hydrological disruption.	No mitigation measures are required.	No residual impacts.

POTENTIAL IMPACT	SIGNIFICANCE OF POTENTIAL IMPACT	PROPOSED MITIGATION MEASURES	PREDICTED RESIDUAL IMPACT
DIRECT MORTALITY			
Mortality Impacts on Fauna	Direct mortality on terrestrial mammals is predicted to be low assuming precautionary checks are carried out before construction to ensure the Project Elements and their immediate vicinity are not used by Eurasian Otters. All non-agile fauna is potentially vulnerable to mortality during site clearance; terrestrial fauna during construction; and birds (due to collision) during operation. However the number of potential targets is low; hence potential impacts are considered to be of Low Severity.	**Avoidance:** Direct mortality of roosts/nests to be avoided by checking haul roads and Project Element footprints prior to site clearance . If roosts or breeding species are found, appropriate measures should be taken to avoid adverse impact, including adjustments to the timing of works.	Residual impacts of Low Severity
OTHER IMPACTS (NOISE, GLARE, DUST AND RUN-OFF)			
Noise arising from construction vehicles	**Low** significance except in the area where Collared Crows form a pre-roost, on which species the impact could be of **Moderate** significance.	All construction activity associated with TH2, including the passage of construction vehicles, will cease two hours before sunset.	Residual impacts of Low Severity
CUMULATIVE IMPACTS			
Disturbance impacts from concurrent projects.	No concurrent projects, and thus no cumulative impacts.	None required.	No residual impact.

7.11 References

AFCD. 2003. *Rare and Precious Plants of Hong Kong*. AFCD, HKSAR, Hong Kong.

AFCD. 2007. *Flora of Hong Kong Vol. 1*. Edited by Hong Kong Herbarium, AFCD & South China Botanical Garden, Chinese Academy of Sciences.

AFCD. 2008. *Flora of Hong Kong Vol. 2*. Edited by Hong Kong Herbarium, AFCD & South China Botanical Garden, Chinese Academy of Sciences.

AFCD. 2009. *Flora of Hong Kong Vol. 3*. Edited by Hong Kong Herbarium, AFCD & South China Botanical Garden, Chinese Academy of Sciences.

AFCD. 2011. *Flora of Hong Kong Vol. 4*. Edited by Hong Kong Herbarium, AFCD & South China Botanical Garden, Chinese Academy of Sciences.

AFCD. 2012a. *Check List of Hong Kong Plants 2012*. AFCD, HKSAR, Hong Kong.

AFCD. 2016. *Hong Kong Biodiversity Strategy and Action Plan 2016-2011*. Environment Bureau. AFCD.

AFCD. 2017. Hong Kong Biodiversity Database (February 2017) online at https://www.afcd.gov.hk/english/conservation/hkbiodiversity/database/search.php

Anon. 1997. *Study on the Ecological Value of Fishponds in Deep Bay Area*. Report by Aspinwall & Co. Hong Kong Ltd. In association with Wetlands International to PlanD.

Anon. 2007. *Summer 2007 Report: Egretry Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site*. Report by HKBWS to AFCD.

Anon, 2008. *Summer 2008 Report: Egretry Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site*. Report by HKBWS to AFCD.

Anon. 2009. *Summer 2009 Report: Egretry Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site*. Report by HKBWS to AFCD.

Anon, 2010. *Summer 2010 Report: Egretry Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site*. Report by HKBWS to AFCD.

Anon, 2011. *Summer 2011 Report: Egretry Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site*. Report by HKBWS to AFCD.

Anon. 2012. *Summer 2012 Report: Egretry Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bat Ramsar Site*. Report by HKBWS to AFCD.

Anon. 2013. *Summer 2013 Report: Egretry Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bat Ramsar Site*. Report by HKBWS to AFCD.

Anon. 2014. *Summer 2014 Report: Egretry Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bat Ramsar Site*. Report by HKBWS to AFCD.

Anon. 2015a. *Summer 2015 Report: Egretry Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site*. Report by HKBWS to AFCD.

Anon. 2015b. *Mai Po Inner Deep Bay Ramsar Site Waterbird Monitoring Programme 2014 – 15. Monthly Waterbird Monitoring. Biannual Report 2, October 2014 to March 2015*. Report by HKBWS to AFCD Government.

Anon. 2016. *Summer 2016 Report: Egretry Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site*. Report by HKBWS to AFCD.

Ballantyne, Lesley, Fu, Xin Hua, Shih, Chun-Hat, Cheng, Chui-Yu, Yiu, Vor. 2011. *Pteroptyx maipo Ballantyne, a new species of bent-winged firefly (Coleoptera: Lampyridae) from Hong Kong, and its relevance to firefly biology and conservation*. Zootaxa 2931: 8-34

Baretto, G. Cribb, P. & Gale, S. 2011. *The Wild Orchids of Hong Kong*. Natural History Society Publications (Borneo), Kota Kinabalu and Kadoorie Farm & Botanic Garden, Hong Kong.

Binnie, Black and Veatch. 2002. Sheung Shui to Lok Ma Chau Spur Line. EIA-71/2001. At:

https://www.epd.gov.hk/eia/english/register/aeiara/nd.html

CH2M Hill. 2008. Proposed Development at Fung Lok Wai, Yuen Long, Lot 1457 R.P. in D.D. 123. EIA-149/2008. At: https://www.epd.gov.hk/eia/english/register/aeiara/yld.html.

Holland, W. J. 1931. *The Butterfly book.* Garden City, New York: Doubleday, Doran & Co.

Jiang, Z.G., Jiang, J.P., Wang, Y.Z., Zhang, E., Zhang, Y.Y., Li, L.L., Xie, F., Cai, B., Cao, L., Zheng, G.M., Dong, L., Zhang, Z.W., Ding, P., Luo, Z.H., Ding, C.Q., Ma, Z.J., Tang, S.H., Cao, W.X., Li, C.W., Hu, H.J., Ma, Y., Wu, Y., Wang, Y.X., Zhou, K.Y., Liu, S.Y., Chen, Y.Y., Li, J.T., Feng, Z.J., Wang, Y., Wang, B., Li, C., Song, X.L., Cai, L., Zang, C.X., Zeng, Y., Meng, Z.B., Fang, H.X., and Ping, X.G., 2016. *Red List of China's Vertebrates (RLCV)*. Biodiversity Science: 24 (5) 500-551.

Karsen, S.J., Lau, M.W.N. & Bogadek A. 1998. *Hong Kong Amphibians and Reptiles*. Provisional Urban Council Hong Kong.

Ma, C.K.W. 2014. *Post-release monitoring of the northward migration of a Great Cormorant Phalacrocorax carbo sinensis from its wintering site in Hong Kong*. *Hong Kong Bird Report 2012*: 255-277

McMillan, S.E., Hau, B.C.H. and Bonebrake, T.C. 2020. Eurasian Otter Conservation: contrasting experiences in the UK and Hong Kong. *In Practice* Issue 107, March 2020.

McMillan, S.E., Wong, T.C., Hau, B.C.H. and Bonebrake, T.C. 2019. Fish farmers highlight opportunities and warnings for urban carnivore conservation. *Conservation Science and Practice 2019*. DOI: 10.1111/scp2.79.

Shek, C. T. 2006. *A Field Guide to the Terrestrial Mammals of Hong Kon*g. Friends of the Country Parks, Cosmos Books, Hong Kong.

Shek, C., J. W. K. So, C., T. Y. Lau, C. S. M. Chan, A. O. Y. Li, W. S. H. Chow, and C. S. K. Liu. 2012. *Experimentation on the use of bat boxes in Hong Kong*. Hong Kong Biodiversity (AFCD Newsletter), 22: 10-15.

Stanton, D.J. & J.A. Allcock (2011). *Habitat characteristics and odonate communities at selected sites used by Mortonagrion hirosei Asahina (Zygoptera: Coenagrionidae) in Hong Kong*. Journal of Threatened Taxa 3(12): 2242–2252. Xing, F.W., Ng, S.C., Chau, L.K.C. 2000. Gymnosperms and angiosperms of Hong Kong. Memoirs of the Hong Kong Natural History Society 23: 21-136.

Stanton, D.J., Smith, B. & Leung, K.K.S. (2014). Collared Crow *Corvus torqauatus* at the Mai Po Nature Reserve, Hong Kong. Forktail 30 (2014): 79-83.

Van der Grift, E.A and Kuijsters, R.M.J. (1998). Mitigation measures to reduce habitat fragmentation by railway lines in the Netherlands. *ICOWET* February 9-12: 166-170.

WWF Hong Kong. 2013. *Mai Po Nature Reserve Habitat Management, Monitoring and Research Plan 2013-2018. Volume I Habitat Management*. WWF Hong Kong, Hong Kong.

8 FISHERIES IMPACT

8.1 Introduction

8.1.1 This fisheries impact assessment has been carried out to identify, qualify and quantify potential fisheries impacts arising from the construction and operation of the Project. The criteria and guidelines listed in Annex 9 and Annex 17 of the EIAO-TM are referred to.

8.1.2 It should be noted that fisheries impacts refer to the impacts to the fisheries industry – in this case the commercial fishponds adjacent to the Project Site – and not the impact to the fish themselves. The impacts to wildlife were considered in ***Chapter 7***.

8.2 Legislation, Standards and Guidelines

8.2.1 In carrying out the fisheries assessment, reference has been made to the following relevant legislation, documents and guidelines:

- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499)
- Technical Memorandum on Environmental Impact Assessment Process (TM-EIAO), Annexes 9 and 17

8.3 Potential Impacts and Assessment – Construction Stage

Assessment Methodology

8.3.1 A literature review and internet search have been conducted to assess the baseline status of pond fish culture activity within the assessment area (500m from the Project Site Boundary) as well as elsewhere in Hong Kong:

- AFCD annual reports (2000 to 2017-18) http://www.afcd.gov.hk/english/publications/publications_dep/publications_dep.html
- AFCD website http://www.afcd.gov.hk/english/fisheries/fish_aqu/fish_aqu.html
- AFCD Accredited Fish Farm Scheme Website http://www.hkaffs.org/en/index.htmlOther

8.3.2 Other relevant EIA reports, viewed from the EPD Website (http://www.epd.gov.hk/eia/english/register/aeiara/all.html) include:

- Development of Lok Ma Chau Loop, EIA-212/2013
- North East New Territories New Development Areas (EIA-213/2013)
- Comprehensive Development and Wetland Protection near Yau Mei San Tsuen (EIA-227/2015)
- Proposed Low-rise and Low-density Residential Development at Various Lots and their Adjoining Government Land in DD 104, East of Kam Pok Road, Mai Po (EIA-242/2016)
- Hung Shui Kiu New Development Area (EIA-248/2016)

8.3.3 In addition to desktop survey, site visits were undertaken to investigate actual fisheries status within the assessment area between January and November 2017. Activities related to fisheries observed during other field surveys were also recorded. During site visits, local villagers, fish farmers and pond owners were interviewed.

8.3.4 Ponds observed were categorised as follows:

- **Active.** Currently utilized for commercial aquaculture activities, including commercial fishponds, fish fry ponds and water flea ponds.
- **Inactive.** No current commercial aquaculture activities, but no major physical constraints to its resumption in the short-term, including ponds with fish present in non-commercial quantities and ponds for casual sport fishing or water sports.

- **Abandoned.** Ponds in which there is physical evidence that no aquaculture has occurred for many years (typically ponds overgrown with vegetation) and/or where there are obvious physical constraints to the resumption of fisheries activity (e.g., ponds which are fenced off and thus inaccessible); concreted ornamental ponds are also included in this category.
- **Gei wai.** These ponds are a main feature of MPNR and are classified here separately given their management for conservation purposes.

Baseline Condition

8.3.5 Pond fish culture has been centred in the northwestern New Territories for a long period of time. Traditionally, primarily freshwater fish and several brackish species, such as Bighead Carp *Aristichthys nobilis*, Edible Goldfish *Carassius auratus*, Grass Carp *Ctenopharyngodon idellus*, Mud Carp *Cirrhinus chinensis*, Flathead Mullet *Mugil cephalus* and Nile Tilapia *Oreochromis niloticus*, are farmed. However, in recent years, certain high-value marine species such as Giant Grouper *Epinephelus lanceolatus*, Yellowfin Seabream *Acanthopagrus latus* and Spotted Scat *Scatophagus argus* have also been cultured in diluted seawater by fish farms close to the coast (e.g. at Mai Po). Most ponds in Hong Kong practice polyculture of carp, tilapia and/or grey mullet[Ref.#13].

8.3.6 Several fish farms have started to culture new species and AFCD has carried out much promotional work. According to the data extracted from AFCD's website and AFCD's annual reports, the production of pond fish in Hong Kong has stabilised in recent years. Annual pond fish production and fishpond area in the territory are listed in ***Table 8-1***.

Table 8-1 Annual Pond Fish Production and Fishpond Area

YEAR	POND FISH PRODUCTION (TONNES)	FISHPOND AREA (ha)	OVERALL POND FISH PRODUCTION RATE (kg/ha/YEAR)
2000	2,817	1,060	2,657
2001	2,550	1,059	2,407
2002	1,989	1,030	1,931
2003	2,114	1,029	2,054
2004	1,977	1,026	1,927
2005	1,897	1,026	1,849
2006	1,943	1,024	1,897
2007	1,927	1,160	1,661
2008	2,266	1,160	1,953
2009	2,105	1,160	1,814
2010	2,190	1,109	1,975
2011	2,315	1,130	2,049
2012	2,306	1,150	2,005
2013	2,187	1,150	1,902
2014	2,001	1,140	1,755
2015	2,092	1,140	1,835
2016	2,543	1,135	2,240
2017	2,543	1,132	2,246
2018	2,500	1,130	2,212
2019	2,278	1,131	2,014
2020	2,516	1,130	2,226

Source: AFCD Annual Reports, 2000 to 2020 and Ref. #12.

13. AFCD (2020), Marine Fish Culture, Pond Fish Culture and Oyster Culture. www.afcd.gov.hk/english/fisheries/fish_aqu/fish_aqu_mpo/fish_aqu_mpo.html

8.3.7 According to the latest information from AFCD[Ref.#12], local pond fish production accounted for approx. 75.7% of production of the aquaculture sector, valued at more than $60 million in 2020.

8.3.8 There are no capture fisheries known within the assessment area, and no assessment of impacts thereon has been carried out. Any polluted runoff from work areas will be isolated from Deep Bay as explained from ***Section 5.4.12 to 5.4.31,*** and hence no adverse water quality impact to fisheries resources in Deep Bay are predicted.

Site Investigation

Project Site

8.3.9 According to base maps, aerial photos and site visits, there are no fishponds within the Project boundary. Whilst the Gei wai within MPNR are traditional tidal shrimp ponds constructed in coastal areas, these are no longer considered a fisheries resource; instead they are managed for nature conservation.

Assessment Area

8.3.10 Commercial fishponds are present within the 500m assessment area, mainly located around the northern perimeter of MPNR (Tam Kon Chau) and to the south of the Project Site (Lut Chau and Tai Sang Wai). ***Figure 8-1*** shows the location of fishponds, fish culture zones and oyster production within Hong Kong. ***Figure 8-2*** shows the fishpond locations adjacent to the Project Site.

Summary of Site Investigation

8.3.11 ***Table 8-2*** summaries the status and area of the ponds within the assessment area. The total area of the fishponds is very small when compared to the 1,130 ha of fishponds in Hong Kong.

Table 8-2 Status and Area of Ponds Within the Assessment Area

AREA	CATEGORY	FISHERY STATUS	TOTAL AREA (ha)
Project Site	Gei wai	No fisheries status	190.89
Assessment Area	Active	Commercial fishponds	127.54
	Inactive	Production of fish for self-consumption or not in a commercial manner	0.67
	Abandoned	Abandoned/ overgrown/ ornamental/ mitigation ponds	13.64

Identification and Evaluation of Impacts

8.3.12 There will be no direct fishery impact during construction phase as no ponds have been identified within the Project Site. The range of potential indirect impacts is as follows:

- **Blockage of Existing Access.** There is the potential for access to fishponds to be blocked due to construction works, which may have an impact on management activities and fisheries production. According to the current design, the construction work will not adversely affect the access to the closest ponds in Tam Kon Chau. Hence, there is no significant impact to active fishponds.
- **Temporary Occupation of Fishponds.** There will be no temporary occupation of fishponds, hence this impact is not anticipated.
- **Deterioration of Water Quality.** As discussed in ***Section 5***, there will be zero polluted runoff from the works. Specifically, those works areas closest to the commercial fishponds, i.e. the construction of new boardwalk above the main footpath, only minor construction works will be carried out; there will be no concrete breaking or removal, so there will be no dust generation; and there will be no exposed ground, so there will be no risk of muddy water flowing into the ponds. As such, the deterioration of water quality due to construction works is not considered to be a significant impact.

- **Impacts to Capture Fisheries.** No capture fisheries are present within the Survey Area. Hence, no impact is predicted to the capture fisheries during construction.
- **Impacts to Water Systems of Fisheries Importance.** Given the scale of works and distance from open water habitats of Deep Bay, it is considered that construction and/or operational impacts to water systems of fisheries importance (e.g. Deep Bay) are insignificant.

Prediction and Evaluation of Environmental Impacts

8.3.13 The identified impacts on fisheries are expected to be very low and are summarised in ***Table 8-3.*** Good site practices during the construction phase to prevent water pollution is also recommended and discussed in the following section.

Table 8-3 Summary of Construction Stage Impacts to Fisheries

CRITERIA	DESCRIPTION (CONSTRUCTION PHASE)
Nature of impact	No direct impact. Potential indirect impacts include blockage of access roads, hydrological disruption, and deterioration of water quality during construction, which are considered a **Very Low** fisheries impact.
Size of affected area	No direct impact and indirect impacts of very low significance.
Loss of fishery resources/production	
Destruction and disturbance of nursery and spawning grounds	
Loss of fishery resources/production	
Impact on fishery activity	
Impact on aquaculture activity	

Cumulative Impacts

8.3.14 The demolition and rebuild of PSFSC near MPNR will have been completed by March 2022 whereas the construction of this Project will commence at end-April 2022. As such, the demolition and rebuild of PSFSC will not be carried out concurrently with this Project. There are also no other concurrent projects near MPNR. Thus, cumulative fisheries impacts for this Project is not anticipated.

8.3.15 As shown in the Project Programme in ***Figure 2-6***, there are also no concurrent works related to the *MPNR Management Plan 2019-2024* and so no cumulative fisheries impacts.

Mitigation Measures

8.3.16 All fisheries impacts are predicted to be of low significance, hence no mitigation measures are proposed. However, good site practices during the construction to prevent the deterioration of water quality are also recommended.

8.3.17 Illegal dumping of waste and excavated material will be properly managed (see ***Section 6*** for details) and thus such impact is not predicted to occur.

8.3.18 There is the potential for access to fishponds to be blocked due to construction works, which may have an impact on management activities and fisheries production. Temporary traffic arrangements should be instigated to maintain or provide alternative access to fishponds during construction, if required.

Other Indirect Impacts

8.3.19 With the mitigation measures proposed to control dust (***Section 3.8***), water pollution (***Section 5.5***) and waste generation (***Section 6.6***), indirect impacts on fisheries due to construction activities will be insignificant. This includes the fishponds in the vicinity of the Site and also fisheries in the wider area, including oyster farms in Deep Bay and fish culture zones elsewhere.

Residual Environmental Impacts

8.3.20 There will be no direct loss of fishponds due to the development and the indirect impacts are of low significance. With the above measures and measures for mitigating dust, avoiding water pollution and managing waste, no residual impact is anticipated.

8.3.21 No specific quantitative monitoring programme for fisheries is deemed necessary, though regular inspection and audit of the works area should include assessment of potential impacts on adjacent fish culture ponds.

8.4 Potential Impacts and Assessment – Operation Stage

8.4.1 The two new tower hides will not be provided with toilets or washrooms and so no wastewater will be generated. Runoff from the roof of the tower hides and from the footpaths will not be contaminated. As such, there will be no point or non-point pollution sources due to the operation of the Project and therefore no impact to the water systems – fishponds, gei wai or Deep Bay – or associated sensitive receivers within the Project Site or within the Assessment Area for fisheries impact.

8.4.2 Overall, therefore, no adverse fisheries impact is anticipated during the operation stage and no mitigation measures are required.

8.5 Conclusion

8.5.1 There are no commercial fishponds in the Project Area and so there will be no direct impact on fisheries within the Project Area during construction. Adjacent to the Project Site are commercial fisheries. However, with the mitigation measures proposed to control dust (see ***Section 3.8***), water pollution (see ***Section 5.5***) and waste generation (see ***Section 6.6***), indirect impacts on fisheries due to construction activities will be insignificant. This includes the fishponds in the vicinity of the Site and also fisheries in the wider area, including oyster farms in Deep Bay and fish culture zones elsewhere. Overall, therefore, no adverse fisheries impact is anticipated during the construction stage.

8.5.2 The two new tower hides will not be provided with toilets or washrooms and so no wastewater will be generated during the operations stage. Runoff from the roof of the tower hides and from the footpaths will not be contaminated. As such, there will be no point or non-point pollution sources due to the operation of the Project and therefore no impact to the water systems – fishponds, gei wai or Deep Bay – or associated sensitive receivers within the Project Site or within the Assessment Area for fisheries impact. Overall, therefore, no adverse fisheries impact is anticipated during the operation stage.

9 LANDSCAPE AND VISUAL IMPACT

9.1 Introduction

9.1.1 This Landscape and Visual Impact Assessment (LVIA) has been carried out to identify, qualify and quantify potential landscape and visual impacts arising from the construction and operation of the Project. The criteria and guidelines listed in Annex 10 and Annex 18 of the EIAO-TM are referred to and further guidance given by the EIAO Guidance Note 8/2010.

9.1.2 The LVIA includes a review of the planning and development control framework, including review of relevant outline development plan(s), OZPs, and any approved and planned developments in the 500m Assessment Area. The Landscape Impact Assessment (LIA) assesses impacts both on Landscape Resources (LRs) and Landscape character areas (LCAs) in all the areas within 500m from the Project boundary. The Visual Impact Assessment (VIA) identifies and predicts type and extent of impacts from visual obstruction, changes in visual amenity and compatibility of the Project within a defined Assessment Area.

9.1.3 In view of the limited scale of the Project, which comprises new boardwalk and low-rise buildings (proposed Tower Hides), the VIA for the purposes of this EIA only focuses on local Visually Sensitive Receivers (VSRs) and the Assessment Area for VIA is defined by the primary Zone of Visual Influence (ZVI) within which the Project can be viewed by local VSRs.

9.1.4 Specific objectives of the LVIA include:

- Definition of the scope of the LIA and VIA including description of the assessment methodologies.
- Review of relevant planning and development control framework.
- To conduct a baseline study to describe, appraise, analyse and evaluate the existing and planned LRs and LCAs of the Assessment Area.
- Identification and plotting of a visual envelope which defines the ZVI of the Project.
- Identification of the key groups of existing and planned sensitive receivers within the visual envelope with regards to views from ground level and elevated vantage points.
- Description of the visual compatibility of the Project with the existing and planned visual context, and its obstruction and interference with the key views within the visual envelope.
- Identification and description of the severity of visual impact in terms of nature, distance and number of sensitive receivers. The visual impact of the Project with and without mitigation measures is included and illustrated so as to demonstrate the effectiveness of the proposed mitigation measures across time.
- Evaluations and explanations with supportive arguments of factors considered in arriving at the significance thresholds of visual impact.
- Recommendation of effective and practicable mitigation/ enhancement measures, and identification and evaluation of the acceptability of residual impacts.

9.2 Legislation, Standards and Guidelines

9.2.1 The LVIA has been conducted with reference to the local legislation, guidelines, plans and relevant studies as follows:

- EIAO, Cap. 499 Guidance Note No. 8/2010
- Annexes 10 and 18 to the EIAO-TM
- Study on Landscape Value Mapping of Hong Kong
- Landscape Character Map of Hong Kong (PlanD, 2005)
- Hong Kong Planning Standards and Guidelines (HKPSG) Chapters 4, 10 and 11
- *Town Planning Ordinance* (Cap. 131)

- *Forest and Countryside Ordinance* (Cap. 96)
- *Protection of Endangered Species of Animals and Plants Ordinance* (Cap. 586)
- Check List of Hong Kong Plants 2012 (AFCD, 2012)
- Rare and Precious Plants of Hong Kong 2003 (AFCD,2003)
- AFCD Nature Conservation Practice Note Nos. 01, 02 (Rev. Jun 2006) and 03
- Guidelines on Tree Preservation during Development (Greening, Landscape and Tree Management Section, Development Bureau, April 2015)
- Guidelines on Tree Transplanting (Greening, Landscape and Tree Management Section, Development Bureau, September 2014)
- DEVB TC No. 4/2020 – Tree Preservation
- DEVB TC No. 6/2015 – Maintenance of Vegetation and Hard Landscape Features
- DEVB TC No.3/2012 – Site Coverage of Greenery for Government Building Projects
- ETWB TCW No. 5/2020 – Registration and Preservation of Old and Valuable Trees
- ETWB TCW No. 34/2003 – Community Involvement in Greening Works
- WBTC No. 7/2002 – Tree Planting in Public Works
- Approved Mai Po and Fairview Park OZP No. S/YL-MP/6

9.3 Assessment Methodology

Landscape Baseline Review and Impact Assessment

Identification and Examination of Baseline LRs and LCAs

9.3.1 With reference to the most recently published studies, literature, topographical maps and aerial photographs, available LRs and LCAs within the 500m Assessment Area were identified and mapped on a plan based on a government base map. Supplementary field surveys were conducted in December 2017, September and October 2020 to verify the extent and conditions of the identified LRs and LCAs. Possible landscape resources include natural components of landscape such as soil, vegetation communities, water bodies (hydrology), geological and topographical features, and man-made features such as pattern of settlement of built features and green building features.

9.3.2 The LCAs formed by various broadly homogenous units of similar landscape characters within the 500m Assessment Area have been identified and mapped on a plan with reference to the Landscape Character Map of Hong Kong.

Assessment of Sensitivity of LRs/LCAs

9.3.3 With reference to the study of Landscape Value Mapping of Hong Kong and other relevant information, sensitivity of LRs and LCAs is rated as ‘high’, ‘medium’ or ‘low’ and are influenced by rarity, importance, quality and maturity, statutory or regulatory limitations/ requirements and the ability of LRs and LCAs to accommodate change.

Identification of Sources and Magnitude of Potential Landscape Impacts

9.3.4 Potential sources of landscape impacts could arise from construction and operation of the Project. The magnitude of changes for assessing landscape impacts depends on the following criteria:

- Compatibility of the Project with the surrounding landscape
- Duration of impacts under construction and operational phases
- Scale of development
- Reversibility of change

9.3.5 The magnitude of landscape change is classified as follows:

- **Large**: the landscape or landscape resources would suffer a major change.
- **Medium**: the landscape or landscape resources would suffer a moderate change.
- **Small**: the landscape or landscape resources would suffer slight or barely perceptible changes.
- **Negligible**: the landscape or landscape resources would suffer no discernible change.

Identification of Potential Landscape Mitigation and Enhancement Measures

9.3.6 Possible landscape mitigation measures may include minimization of extent and duration of construction works, adoption of alternative design, and implementation of mitigation measures, such as landscape planting to provide visual buffers/ screening.

Significance of Landscape Impacts

9.3.7 The significance of landscape impacts before and after implementation of mitigation and/ or enhancement measures are defined as follows:

- **Substantial**: Adverse/ Beneficial impact where the proposal would cause significant deterioration or improvement in existing landscape quality.
- **Moderate**: Adverse/ Beneficial impact where the proposal would cause a noticeable deterioration or improvement in existing landscape quality.
- **Slight**: Adverse/ Beneficial impact where the proposal would cause a barely perceptible deterioration or improvement in existing landscape quality.
- **Insubstantial**: No discernible change in existing landscape quality.

9.3.8 The degree of significance of landscape impacts has been derived from the combination of the magnitude of change and the sensitivity/ tolerance of the sensitive receivers to change as shown in ***Table 9-1***.

Table 9-1 Matrix Showing Impact Significance of Landscape and Visual Impacts

IMPACT SIGNIFICANCE		SENSITIVITY OF RECEIVERS		
		LOW	MEDIUM	HIGH
MAGNITUDE OF CHANGE	LARGE	Moderate	Moderate/ Substantial	Substantial
	MEDIUM	Slight/ Moderate	Moderate	Moderate/ Substantial
	SMALL	Slight	Slight/Moderate	Moderate
	NEGLIGIBLE	Insubstantial	Insubstantial	Insubstantial

Visual Baseline Review and Impact Assessment

Identification and Examination of ZVI and VSRs

9.3.9 In view of the limited scale of the Project, the Assessment Area for visual impacts has been defined as a visual envelope covering the primary ZVI within which the Project can be viewed by local VSRs. The ZVI and the affected key groups of VSRs were initially identified from topographical maps and aerial photographs, and the exact extent of ZVI and the visibility of local VSRs were further verified by site surveys conducted in December 2017, September and October 2020, and March 2021 The local VSRs to be affected by the Project are categorized as follows:

- **Functional (F)** who view the Project from their workplaces, institutional and educational buildings
- **Residential (R)** who view the Project from their homes
- **Leisure (L)** who view the Project when they are enjoying leisure or recreational activities

Assessment of Sensitivity of VSRs

9.3.10 The sensitivity of VSRs to change is rated as 'high', 'medium' or 'low' as influenced by the value and quality of existing views, availability and amenity of alternate views, type and estimated population of VSRs, duration or frequency of view and degree of visibility.

Identification of Sources and Magnitude of Potential Visual Impacts

9.3.11 Potential sources of visual impacts could arise from both construction and operational phases of the Project. Factors to be considered in determining the magnitude of changes in assessment of visual impacts include:

- Compatibility of the Project with the surrounding landscape
- Duration of impacts under construction and operational phases
- Scale of development
- Reversibility of change
- Viewing distance
- Potential blockage of view

9.3.12 The magnitude of visual change is classified as follows:

- **Large**: VSRs would suffer a major change in their viewing experience
- **Medium**: VSRs would suffer a moderate change in their viewing experience
- **Small**: VSRs would suffer a slight change in their viewing experience
- **Negligible**: VSRs would suffer no discernible change in their viewing experience

Identification of Potential Visual Mitigation and Enhancement Measures

9.3.13 Possible visual mitigation measures will primarily take the form of adoption of alternative design to avoid or minimize visual obstruction resulting from the Project, careful consideration of the orientation, colour and texture treatment of building features and finishes to soften the outlook of building structures; and provision of green features and screening to neutralize negative impacts from hard elements.

9.3.14 Photomontages were prepared based on photographs taken at representative vantage points/ viewpoints to illustrate visual impacts during Project operation in relation to other existing and known planned developments and prominent visual features.

Significance of Visual Impacts

9.3.15 The degree of significance of visual impacts has been derived from the combination of the magnitude of change and the sensitivity/ tolerance of the receivers (i.e. VSRs) to change as shown in ***Table 9-1***, above. The significance of visual impacts before and after implementation of mitigation and enhancement measures are defined as follows:

- **Substantial**: Adverse/Beneficial impact where the proposal would result in significant deterioration or improvement in existing visual quality perceived by the general population
- **Moderate**: Adverse/Beneficial impact where the proposal would result in a noticeable deterioration or improvement in existing visual quality perceived by the general population
- **Slight**: Adverse/Beneficial impact where the proposal would result in a barely perceptible deterioration or improvement in existing visual quality perceived by the general population
- **Insubstantial**: No discernible change in visual quality perceived by the general population

Acceptability of Residual Landscape and Visual Impacts

9.3.16 The acceptability of residual landscape and visual impacts after implementation of recommended mitigation/ enhancement measures were predicted in accordance with the criteria as set out in Annex 10 of EIAO-TM as follows:

- **Beneficial**: The Project will complement the landscape and visual character of its setting, will follow the relevant planning objectives and will improve overall and visual quality.
- **Acceptable**: There will be no significant effects on the landscape, no significant visual effects caused by the appearance of the project, or no interference with key views.
- **Acceptable with mitigation measures**: There will be some adverse effects, but these can be eliminated, reduced or offset to a large extent by specific measures.
- **Unacceptable**: Significant adverse effects are likely, but the extent to which they may occur or may be mitigated cannot be determined from the Study. Further detailed study will be required for the specific effects in question.

9.4 Review of Planning and Development Control Framework

9.4.1 The 500m Assessment Area of the Project is covered by the approved Mai Po and Fairview Park OZP No. S/YL-MP/6. The 500m Assessment Area covers Tai Long Kei and Shek Shan SSSI and a large portion of Lut Chau SSSI, the adjoining Conservation Area (CA), Residential Group (C) zone (part of the residential area of Fairview Park and Palm Springs), and a Government, Institute or Community (G/IC) zone (i.e. the existing PSFSC and the Hong Kong Police Force Pak Hok Chau Operational Base), as shown in ***Figure 9-1***.

9.4.2 The Project Site (211.7ha) is located within the 372.1ha Tai Long Kei and Shek Shan SSSI. The planning intention of this zone is to conserve and protect the features of special scientific interest, such as rare or particular species of fauna and flora and habitats, corals, woodlands, marshes or areas of geological, ecological or botanical/biological interest. It intends to deter human activities or developments unless they are needed to support the conservation of the features of special scientific interest in the SSSI, to maintain and protect the existing character of SSSI, or for educational and research purposes. The Project Elements include construction of TH2 and TH3, widening and renewal works to existing footpath to TH1, and new footpaths connecting TH2 and TH3, fall within the uses of "Column 2" of the OZP Notes. As such, permission from the Town Planning Board (TPB) under Section 16 of the Town Planning Ordinance is required. All the proposed works aim to provide new education components and are considered to fully comply with the planning intention and development control framework as stipulated within the OZP.

9.4.3 The adjoining Lut Chau SSSI zone is intended to conserve the ecological value and function of the existing fish ponds within the zone and to deter development (other than those which are necessary to sustain or enhance the ecological value of the fish ponds within the zone or to serve educational or research purpose) within this zone.

9.4.4 The CA zone on the eastern side of Mai Po Marshes SSSI (i.e. Tai Long Kei and Shek Shan SSSI and Lut Chau SSSI) is intended to conserve the ecological value of wetland and fish ponds which form an integral part of the wetland ecosystem in the Deep Bay Area.

9.4.5 According to *TPB Guidelines No. 12C (TPB PG-No. 12C)*, the Tai Long Kei and Shek Shan SSSI, Lut Chau SSSI(1) and the CA zone described above fall within the Wetland Conservation Area (WCA) within which the principle of "no-net-loss in wetland" applies. The "no-net-loss" can refer to both loss in "area" and "function", whether caused by habitat loss or adverse disturbance impact. New developments are discouraged unless they are required to support conservation of ecological integrity of wetland ecosystem or the development is an essential infrastructure project overriding public interest.

9.4.6 Further to the southeast of the Project site are the existing residential areas (parts of Fairview Park and Palm Springs) which are zoned as R(C). This zone is intended primarily for low-rise, low-density residential developments where commercial uses serving residential neighbourhood may be permitted on application to the TPB.

9.4.7 The G/IC zone at the end of Tam Kon Chau Road is intended primarily for the provision of Government, institution or community facilities serving the needs of local residents and the

district population. There is no planning stipulation on building height, plot ratio or site coverage according to the OZP.

9.5 Landscape and Visual Baseline Study

Landscape Resources

9.5.1 The identified LRs were classified into three categories based on their nature: LR1 – Vegetation; LR2 – Water Bodies (Hydrology); and LR3 – Developed Area. ***Table 9-2*** lists the LRs identified within the 500m Assessment Area.

Table 9-2 List of LRs within the 500m Assessment Area

REF.	LANDSCAPE RESOURCES	EXTENT (m^2)
LR1 – VEGETATION		
LR1-1	Mangrove	1,268,814
LR1-2	Brackish Marsh	216,600
LR1-3	Wooded Area	9,068
LR1-4	Reed (within Gei Wai and Rain-fed Pond)	N.A.
LR2 – WATER BODIES (HYDROLOGY)		
LR2-1	Brackish Gei Wai	1,626,739
LR2-2	Rain-fed Pond	492,035
LR2-3	Commercial Fishpond	1,668,279
LR2-4	Channelised Watercourse	10,064
LR2-5	Watercourse	170,241
LR2-6	Buffalo Marsh	20,000
LR3 – PLANTING SURROUNDING DEVELOPNENT AREA		
LR3-1	Planting surrounding Development Area	550,464

Note: The extent of reed and mangrove stands within the water bodies (i.e. Gei Wai and rain-fed ponds) are dynamics and can vary from time to time due to seasonal changes and vegetation management. The approximate extent of these vegetation within ponds are indicated in ***Figure 9-2***, and their area(s) are included in the calculated areas of their corresponding ponds/ water bodies.

9.5.2 ***Figure 9-2*** shows the locations and extent of the LRs and ***Figure 9-3*** provides a photographic record showing typical views of each of these LRs, with ***Photograph 9-1*** showing examples of the most prevalent types of LR.

Photograph 9-1 Top Three LRs by Extent



LR1-1 Mangrove



LR2-1 Brackish Gei Wai



LR2-3 Commercial Fish Pond

LR1 – Vegetation

LR1-1 Mangrove

9.5.3 This is the most extensive vegetation type within the 500m Assessment Area. The entire **LR1-1** falls within Mai Po Inner Deep Bay Ramsar Site. A Ramsar Site is a designated wetland site considered to be of internationally importance under the Ramsar Convention (an intergovernmental treaty signed on 2 February 1971 in the city of Ramsar in Iran and entered into force in 1975). Most of LR1-1 occurs within the MPNR outside the Boundary Fence. It forms a part of the largest mangrove community in Hong Kong. Dominant species include the mangrove trees *Kandelia obovata* and *Aegiceras corniculatum*, and climbers such as *Derris trifoliata* and *Paederia scandens*. **LR1-1** is a unique natural landscape in the Deep Bay Area with minimal human intervention. It is considered to have low ability to accommodate change arising from developments. As part of the Ramsar Site, **LR1-1** is considered to be of regional importance and the sensitivity of **LR1-1** is considered to be **High**.

LR1-2 Brackish Marsh

9.5.4 The brackish marshes are located at the banks of the natural watercourses running between Shek Shan and Mai Po, as well as along the southeastern perimeter of MPNR. **LR1-2** falls entirely within Mai Po Inner Deep Bay Ramsar Site. These brackish marshes are subject to tidal influence and are dominated by marsh ferns including Mangrove Fern *Acrostichum aureum* and Interrupted Tri-vein Fern *Cyclosorus interruptus*, wetland plant species *Eichhornia crassipes*, *Brachiaria mutica* and *Ipomoea aquatic*a, and interspersed with patches of reeds (*Phragmites australis*). As a unique natural landscape in the Deep Bay Area with minimal human intervention, **LR1-2** is considered to have low ability to accommodate change arising from developments. **LR1-2** is considered to be part of the regionally importance landscape resources of the Ramsar Site. Due to its high naturalness and unique nature, **LR1-2** is considered to be of **High** sensitivity to change.

LR1-3 Wooded Area

9.5.5 **LR1-3** refers to the two wooded patches outside the Project site, one at Shek Shan within MPNR, and the other on the knoll at Tam Kon Chau Police Post and its adjacent area next to PSFSC. **LR1-3** falls within Mai Po Inner Deep Bay Ramsar Site. The wooded area at Shek Shan is small and isolated. It is dominated by naturally regenerated native tree species such as *Ficus microcarpa*, *Ficus tinctoria* and *Ficus subpisocarpa*. The wooded area at Tam Kon Chau is subject to higher levels of human disturbance as evidenced by the presence of household waste and construction materials in the woodland understory. This wooded area is dominated by typical native tree species of woodland fringe areas, including *Macaranga tanarius* var. *tomentosa*, *Microcos nervosa*, *Ficus elastica* and *Ficus microcarpa*, and common fruit trees such as *Litchi chinensis* and *Sygium jambos*. Both of these wooded areas are small in size and very common and widespread features in Hong Kong. **LR1-3** is readily re-creatable through replanting. As such, it is considered to have a medium ability to accommodate change arising from developments. The sensitivity of **LR1-3** is considered to be **Low**.

LR1-4 Reed

9.5.6 LR1-4 is derived from colonization of reed *Phargmites australis* into the water bodies (brackish gei wai or rain-fed ponds). With varying water level due to seasonal changes and active management, the extent of reed within these water bodies can vary from time to time. **LR1-4** is readily re-creatable through replanting or natural recolonization. As such, it is considered to have a medium ability to accommodate change from developments. The sensitivity of **LR1-4** is considered to be **Medium** given it is a natural component of the existing ponds and within the regionally important Rasmar Site.

LR2 – Water Bodies (Hydrology)

LR2-1 Brackish gei wai

9.5.7 Brackish gei wai is the most dominant LR type within the Project Site and within the boundary of Mai Po Inner Deep Bay Ramsar Site. These water bodies are connected with the tidal water of Deep Bay through operational sluice gates, and are managed either to rear shrimps and fish following traditional practices to provide food for birds, or to provide shallow-water habitats for roosting of waterbirds in MPNR. Some of the gei wai ponds are dominated by mangrove stands such as *Kandelia obovata* and *Aegiceras corniculatum*, whilst in their centres there are small tree islands formed by naturally established tree species such as *Ficus subpisocarpa*, *Macaranga tanarius* var. *tomentosa* and the exotic tree *Melia azedarach*. The bunds between ponds and gei wai are varying in width and height dominated by grasses *Panicum* spp. and common tree and shrub species such as *Macaranga tanarius* var. *tomentosa*, *Melia azedarach and Ficus* spp. Brackish gei wai is a unique landscape feature in Mai Po and the largest area of shrimp culture in Hong Kong, albeit this is no longer undertaken for commercial purposes. The traditional management practices of these tidal shrimp ponds form a unique landscape feature. In view of its uniqueness in the Deep Bay area, **LR2-1** is considered to have low ability to accommodate change arising from developments. **LR2-1** constitutes a key part of the Ramsar wetland which is considered of regional importance. The sensitivity of **LR2-1** is considered to be **High**.

LR2-2 Rain-fed Ponds

9.5.8 These ponds are located within the Project Site and Mai Po Inner Deep Bay Ramsar Site, vary in water depth and contain a mosaic of microhabitats such as open water, stands of reeds, sedges, waterlilies and small tree islands, which are actively managed areas to provide roosting and feeding sites for waterbirds and a wide range of wildlife species in MPNR. The pond bunds are dominated by common tree species such as *Hibiscus tilaceus*, *Celtis sinensis*, *Cerbera manghas*, *Casuarina equisetifolia* and *Macaranga tanarius* var. *tomentosa*. Due to the unique composition and layout of **LR2-2**, and being a key part of the internationally important Ramsar Site and as a unique landscape feature in the Deep Bay area, it is considered to have low ability to accommodate change from developments. **LR2-2** is considered to have **High** sensitivity to change and regionally important landscape resources.

LR2-3 Commercial Fish Ponds

9.5.9 This LR is comprised of mostly active fish ponds and a small number of abandoned fish ponds present both within (at Shek Shan) and outside the MPNR, all within Mai Po Inner Deep Bay Ramsar Site. The fish ponds form extensive clusters at Lut Chau, Pak Hok Chau, Tam Kon Chau and the western area of Mai Po. The pond bunds of the active fish ponds are dominated by grassy vegetation (such as *Brachiaria mutica* and *Panicum maximum*), planted fruit trees (*Litchi chinensis*, *Dimocarpus longan* and *Clausena lansium*) which are typical pond bund vegetation in village areas. The abandoned ponds have been progressively overgrown with vegetation such as grasses, reeds *Phragmites australis* and/or reedmace *Typha angustifolia*, with scattered trees such as *Macaranga tanarius* var. *tomentosa*, *Melia azedarach* and *Hibiscus tiliaceus* along the bunds. Although commercial fishponds are man-made/ modified landscape features and are not uncommon in rural areas, these extensive fishpond clusters are the largest in Hong Kong and form a unique LR in the district context. In view of its man-made/ readily re-creatable nature **LR2-3** is considered to have medium ability to accommodate change arising from developments. The overall sensitivity of **LR2-3** is considered to be **Medium**.

LR2-4 Channelised Watercourse

9.5.10 This LR refers to the only channelised watercourse in the Assessment Area located in the Fairview Park residential estate. It is an artificial feature with a concrete surface occasionally colonized by wetland plant species. This type of LR is very common in Hong Kong and offers limited greening opportunities. As an entire man-made and common feature in the developed areas, **LR2-4** is considered to have high ability to accommodate change arising from developments. The sensitivity of LR2-4 is considered to be **Low**.

LR2-5 Watercourse

9.5.11 **LR2-5** refers to those natural watercourses of varying sizes connecting different types of wetlands and providing drainage to the Assessment Area. **LR2-5** is entirely within Mai Po Inner Deep Bay Ramsar Site. The riparian vegetation are naturally established dominated by species including herbs *Cyperus malaccensis*, *Brachiaria mutica* and *Ludwigia hyssopifolia*, mangal vegetation *Acrostichum aurreum* and *Acanthus ilicifolius* and some tree and shrub species such as *Morus alba*, *Melia azedarach* ad *Musa* x *paradisiaca*. **LR2-5** is a fairly common feature in the New Territories and is largely natural but might have been subject to minor modifications (e.g. channelization/ drainage diversion works at intervals to connect to existing drainage systems). As such, LR2-5 is considered to have medium ability to accommodate change arising from developments. ILR2-5 is considered to have **Medium** sensitivity to change.

LR2-6 Buffalo Marsh

9.5.12 **LR2-6** (pond no. 17b) of approximately 20,000 m^2 was previously a rain-fed pond which was overgrown with spreading reed with little aquatic plants. As a reed control experiment, habitat enhancement work had been implemented by WWF in pond no. 17b since 2020 to remove excessive reeds. Water buffalos had also been introduced to control reed growth and vegetation height through grazing. **LR1-6** was found containing some water in low-lying area portions and little vegetation during the recent site visit. As an actively manged, almost drained pond with little vegetation and low amenity, **LR2-6** is considered to have high ability to accommodate change and **Low** sensitivity to change from developments.

LR3 – Planting Surrounding Development Area

LR3-1 Planting Surrounding Development Area

9.5.13 **LR3-1** mainly refers to the existing plantings in residential areas at Fairview Park and Palm Springs, a few village houses next to the MPNR's entrance, other associated man-made facilities (e.g. PSFSC) in the G/IC zone, and any man-made features (e.g. paved foot-paths) and facilities in MPNR. Landscape resources such as trees/ shrubs in this category is found surrounding/ adjacent to buildings, walls, roads, car parks, and open space, etc. Vegetation in the developed areas are confined to the open space in the residential estates and roadside plantings, dominated by ornamental species such as *Lagerstroemia speciosa*, *Bauhinia* x *blakeana*, *Caryota maxima* and *Archontophoenix alexandrae* and fruit tree species. This type of man-made landscape resources is common and widespread throughout Hong Kong, and is subject to on-going modifications/ redevelopment and undergoing small-scale changes. It is considered to have high ability to accommodate change. Sensitivity of **LR3-1** is considered as **Low**.

9.5.14 The list of LRs and their sensitivity to change are summarised in ***Table 9-3***, below.

Existing Trees Within the Project Site

9.5.15 Based on the Updating Tree Survey Report prepared in March 2021 for this Project (***Appendix D1***), a total of 383 nos. of trees of 22 species were found within the Project Site. No registered or potentially registrable Old and Valuable Tree (OVT) or rare/ protected tree species were recorded within the Project Site. In general, the conditions of the trees within the Project Site were found to be fair to poor. The average tree height was found to be 9m. The dominant native tree species are *Celtis sinensis* and *Cerbera manghas,* and the main exotic plantation species are *Casuarina equisetifolia* and *Melia azedarach*.

9.5.16 As there will be no excavation work along the existing footpath during the construction phase, and the design of the new footpaths has carefully taken into account the existing tree locations, all trees within the Project Site will be retained and no tree felling or pruning is required.

Table 9-3 LRs and their Sensitivity

REF.	LANDSCAPE RESOURCES	QUALITY (HIGH/ MEDIUM/ LOW)	RARITY (HIGH/ MEDIUM / LOW)	IMPORTANCE OF LANDSCAPE RESOURCES IN LOCAL AND REGIONAL CONTEXT (LOCAL/DISTRICT/REGIONAL)	STATUTORY LIMITATIONS/ REQUIREMENTS	ABILITY TO ACCOMMODATE CHANGE (HIGH/MEDIUM/LOW)	SENSITIVITY (HIGH/ MEDIUM/ LOW)
LR1-1	Mangrove	High	High	Regional	SSSI/ Ramsar Site	Low	**High**
LR1-2	Brackish Marsh	High	High	Regional	CA/ Ramsar Site	Low	**High**
LR1-3	Wooded Area	Medium	Low	Local	GIC/SSSI/ Ramsar Site	Medium	**Low**
LR1-4	Reed	Medium	Low	Regional	SSSI/ Ramsar Site	Medium	**Medium**
LR2-1	Brackish gei wai	High	High	Regional	SSSI/ Ramsar Site	Low	**High**
LR2-2	Rain-fed Pond	High	High	Regional	SSSI/ Ramsar Site	Low	**High**
LR2-3	Commercial Fishpond	High	Medium	District	CA/SSSI/SSSI(1)	Medium	**Medium**
LR2-4	Channelised Watercourse	Low	Low	Local	R(C)	High	**Low**
LR2-5	Watercourse	High	Medium	Local	CA/SSSI/SSSI(1)/ Ramsar Site	Low	**Medium**
LR2-6	Buffalo Marsh	Low	Low	Regional	SSSI/ Ramsar Site	High	**Low**
LR3-1	Planting surrounding Development Area	Low	Low	Local	CA/R(C)	High	**Low**

Notes: 1. "Local importance": landscape resources which are generally common and widespread locally; "District importance": landscape resources which are significant to the district; "Regional Importance": landscape resources considered to be of international significance.

Landscape Character Areas

9.5.17 With reference to the Landscape Character Map of Hong Kong (PlanD 2005) and supplemented by field surveys, a total of four LCAs were identified within the 500m Assessment Area as listed in ***Table 9-4*** and described in the following sections.

Table 9-4 List of LCAs within the 500m Assessment Area

REF.	LCA	EXTENT (m^2)
LCA1	Comprehensive Residential Development Area: Fairview Park and Palm Springs	548,620
LCA2	Inter-tidal Coast Landscape: Mai Po Nature Reserve (Frontier Closed Area)	1,298,286
LCA3	Offshore Water Landscape: Shan Pui River and Deep Bay	45,075
LCA4	Rural Coastal Plain Landscape: Mai Po Nature Reserve and Adjacent Ponds	4,253,713

9.5.18 ***Figure 9-4*** shows the locations of these LCAs and ***Figure 9-5*** provides a photographic record showing typical views of each of these LCAs, with ***Photograph 9-2*** showing examples of the most prevalent types of LCA.

Photograph 9-2 Top Three LCAs by Extent



LCA4 Mai Po Nature Reserve



LCA2 MPNR (Frontier Closed Area)



LCA1 Fairview Park and Palm Springs

LCA1 Comprehensive Residential Development Area: Fairview Park & Palm Springs

9.5.19 **LCA1** is characterized as 'Comprehensive Residential Development Area'. It comprises two major low-rise residential development areas (Fairview Park & Palm Springs). They consist of generally low-rise buildings with generous soft landscape provision. The Landscape Value Map of Hong Kong categorises it as 'High (Qualified)' in value. Quality and maturity of LCA1 is considered high given its generous greenery provision and active management to optimize the aesthetic value. LCA1 is considered a common landscape character in the New Territories (i.e. of low rarity) and it has high ability to accommodate change through active management. The sensitivity of **LCA1** is considered as **Low** when it is subject to potential impacts from low-rise developments.

LCA2 Inter-tidal Coast Landscape: Mai Po Nature Reserve (Frontier Closed Area)

9.5.20 **LCA2** is characterized as 'Inter-tidal Coast Landscape' and is largely covered in Tai Long Kei and Shek Shan SSSI. Lying between the high and low water tidal levels, it comprisesextensive mangrove habitats. As mangrove supports high biodiversity from the ecological perspective, as well as being rated as 'High' in value in the Landscape Value Map of Hong Kong, quality and maturity of LCA2 is considered high. Being designated as a SSSI, LCA2 is an uncommon landscape character both locally and internationally. **LCA2** is considered to have low ability to accommodate change arising from developments, and its sensitivity is generally considered as **High** when it is subject to potential impacts from most types of developments.

LCA3 Offshore Water Landscape: Shan Pui River and Deep Bay

9.5.21 **LCA3** is characterized as 'Offshore Water Landscape' which refers to the open water leading from Shan Pui River entering Deep Bay. It forms part of the Mai Po Ramsar site and part of Lut Chau SSSI and thus considered to be of regional importance. **LCA3** is a marine LCA considered as 'High'

in value in the Landscape Value Map of Hong Kong as it is predominately undeveloped and natural, with high quality and maturity. There is only a small portion of this LCA lying along the southwestern margin of the 500m Assessment Area. **LCA3** is considered to be of high sensitivity to change arising from reclamation, quarry or landfill works which are not involved in this Project.

LCA4 Rural Coastal Plain Landscape: Mai Po Nature Reserve and Adjacent Ponds

9.5.22 **LCA4** is characterized as 'Rural Coastal Plain Landscape' and includes the majority of Tai Long Kei and Shek Shan SSSI, part of Lut Chau SSSI and some areas of the CA zone. It comprises commercial fishponds, brackish marshes as well as gei wai. **LCA4** is rated as "High" in value in the Landscape Value Map of Hong Kong. As it comprises an extensive plain of wetland mosaic, it is considered of high quality and amenity and an uncommon landscape character area in Hong Kong. The Project Site is entirely within this **LCA4**. **LCA4** is subject to routine management for conservation purposes. It is considered to be of medium ability to accommodate change. **LCA4** is considered to have **Medium** sensitivity to change due to the proposed works (low-rise developments) of the Project.

9.5.23 A list of LCAs identified in the 500m Assessment and their sensitivity to change are summarised in ***Table 9-5***.

Table 9-5 LCAs and their Sensitivity

REF.	LANDSCAPE CHARACTER TYPE	QUALITY & MATURITY (HIGH/MEDIUM/LOW)	RARITY (HIGH/ MEDIUM/ LOW)	IMPORTANCE (LOCAL/DISTRICT/ REGIONAL)	STATUTORY LIMITATIONS & REQUIREMENTS	ABILITY TO ACCOMMODATE CHANGE (HIGH/MEDIUM/LOW)	SENSITIVITY (HIGH/MEDIUM/LOW)
LCA1	Comprehensive Residential Development Area: Fairview Park & Palm Springs	High	Low	Local	CA/R(C)	High	**Low**
LCA2	Inter-tidal Coast Landscape: Mai Po Nature Reserve (Frontier Closed Area)	High	High	Regional	SSSI	Low	**High**
LCA3	Offshore Water Landscape: Shan Pui River and Deep Bay	High	Medium	Regional	SSSI	Low	**High**
LCA4	Rural Coastal Plain Landscape: Mai Po Nature Reserve and Adjacent Ponds	High	High	Regional	SSSI/CA	Low	**Medium**

Note: 1. "Local importance": landscape character areas which are generally common and widespread locally; "District importance": landscape character areas which are significant to the district; "Regional Importance": landscape character areas considered to be of international significance.

Existing Visual Context

Visually Sensitive Receivers (VSRs)

9.5.24 VSRs of the Project are listed in ***Table 9-6*** and ***Table 9-7,*** below, and the baseline conditions of their views and sensitivity to change during the construction and operation phases of the Project are described as follows. The proposed scheme for visitor routing during construction of Project is shown in ***Appendix D2***.

Table 9-6 List of VSRs

VSR NO.	LOCATION	DISTANCE TO CLOSEST SOURCE (m)	HEIGHT OF VIEWPOINT (mPD)	TYPE OF VIEW (RURAL/DEVELOPED)	TYPE OF VIEW (OPEN/RESTRICTED)	TYPE OF VIEW (STATIC/TRANSIENT)
FUNCTIONAL VSRs						
F-1	Commercial Fishpond	0	6	Rural	Open	Static
F-2	MPEC	0	12	Rural	Restricted	Static
F-3	Along Pond Bund of MPNR (near Pond No.20)	0	0	Rural	Restricted	Transient
LEISURE VSRs						
L-1	Visitors outside the Entrance of MPNR	0	0	Rural	Restricted	Transient
L-2	Visitors in MPNR along the boardwalk	0	0	Rural	Restricted	Transient
L-3	Visitors in Main Tower Hide (TH1)	0	12	Rural	Restricted	Static
RESIDENTIAL VSRs						
R-1	Villagers next to the Entrance of MPNR	23	6	Rural	Restricted	Static

Table 9-7 VSRs and their Sensitivity

VSR NO.	LOCATION	APPLICABLE TO DIFFERENT PHASE (CONSTRUCTION/ OPERATION)	ESTIMATED NO. RECEIVERS (FEW/ TYPICAL/ MANY)	VALUE & QUALITY OF EXISTING VIEW (GOOD/FAIR/POOR)	AVAILABILITY & AMENITY OF ALTERNATIVE VIEWS (GOOD/FAIR/LIMITED)	DEGREE OF VISIBILITY (FULL/PARTIAL/GLIMPSE) CONSTRUCTION	DEGREE OF VISIBILITY (FULL/PARTIAL/GLIMPSE) OPERATION	DURATION OF VIEW (LONG/ MEDIUM/ SHORT)	SENSITIVITY (LOW/ MEDIUM/ HIGH) CONSTRUCTION	SENSITIVITY (LOW/ MEDIUM/ HIGH) OPERATION
FUNCTIONAL VSRs										
F-1	Commercial Fishpond	Con/Op	Few	Good	Good	Glimpse	Glimpse	Medium	Low	Low
F-2	MPEC	Con/Op	Few	Good	Good	Glimpse	Glimpse	Short	Low	Low
F-3	Along Pond Bund of MPNR (near Pond No.20)	Con/Op	Few	Good	Good	Partial	Partial	Short	Medium	Medium
LEISURE VSRs										
L-1	Visitors outside the Entrance of MPNR	Con/Op	Typical	Fair	Fair	Glimpse	Glimpse	Short	Low	Low
L-2	Visitors in MPNR along the boardwalk	Con/Op	Few	Good	Good	Partial	Partial	Short	Medium	Medium
L-3	Visitors in Main Tower Hide (TH1)	Con/Op	Few	Good	Good	Glimpse	Glimpse	Short	Low	Low
RESIDENTIAL VSRs										
R-1	Villagers next to the Entrance of MPNR	Con/Op	Few	Fair	Limited	Glimpse	Glimpse	Short	Low	Low

Zone of Visual Influence

9.5.25 The Project only involves low-rise components (two 3-storey tower hides and new boardwalk above the existing footpath at ground level). The Project Site is surrounded by ponds on all sides and can only be accessed through existing visitor routes of MPNR and some pond bunds of the adjacent commercial fish ponds. In view of the limited footprint of the Project, the Assessment Area for VIA is defined by the ZVI within which the proposed scheme/ works can be viewed only by local VSRs. Types of VSRs and their ZVI are shown on ***Figures 9-6.1***, ***9-6.2*** and ***9-6.3***.

Functional VSRs

9.5.26 Functional VSRs generally refer to those viewers who view the Project from their workplaces, institutional and educational buildings. These viewers are generally more focused on their work or the educational activities that they are engaged in, and are considered to be relatively less sensitive to change compared to Residential VSRs. A total of three Functional VSRs were identified (all are present in very few numbers), including the workers from commercial fish ponds (**F-1**), staff/workers at MPEC (although this is not a true "educational building" such as a school or university) (**F-2**) and workers along the pond bund of MPNR near Pond No. 20 (**F-3**).

9.5.27 For the workers of commercial fish ponds (**F-1**), the only visible Project Element would be a portion of the proposed footpaths along the existing visitor route. Other Project Elements would be significantly screened off by existing tall trees at MPNR. As **F-1** can enjoy 360 degrees of open outdoor view of good amenity value and can possibly view the Project Elements at ground level, the sensitivity of **F-1** to visual change as a result from the Project is considered to be **Low**.

9.5.28 **F-2** refers to a few WWF staff who are working at MPEC and can view a small portion of the works areas of the new footpaths from the small windows or the platform on the second floor of MPEC. **F-2** can glimpse the Project Site when they travel to their workplace. Sensitivity of **F-2** is considered to be **Low**.

9.5.29 **F-3** refers to the very few WWF field workers and researchers working along the pond bund near Pond No. 20. Views of **F-3** are intermittently restricted by existing trees at intervals and they can only view the proposed TH2 and the new access when they come close to the Project site. **F-3** is considered to have **Medium** sensitivity to visual change due to the Project.

Leisure VSRs

9.5.30 Leisure VSRs are viewers who are enjoying leisure, cultural, recreational and/or educational activities and their views could be easily distracted by the immediately adjacent amenity landscapes or activities they are engaged in. Leisure VSRs in this Project refer to the visitors of MPNR; and their views and sensitivity can vary according to their locations: visitors just outside the entrance of MPNR (**L-1**) are considered to have **Low** sensitivity to the Project as they can only glimpse a tiny portion of the Project site (the proposed footpaths). After the visitors enter the MPNR and walk along the visitor route (**L-2**), they can partially view the proposed footpaths and TH3 during construction phase(s) and all other development components during the operation of Project, with most of the views being intermittently blocked by existing trees. The visitors (**L-3**) are considered to be least sensitive when they are bird-watching at the existing tower hide TH1, from which they are only expected to notice minor changes due to the proposed works at TH3 approximately 100m from TH1. Sensitivity of **L-2** and **L-3** to visual change due to the Project is considered to be **Medium** and **Low** respectively.

Residential VSRs

9.5.31 Residential VSRs (**R-1**) refers to the very few village residents next to the entrance of MPNR. **R-1** cannot view the Project site from their home(s). However, **R-1** can glimpse a tiny portion of the proposed footpaths at the entrance of MPNR when they are travelling home. Sensitivity of **R-1** to visual change due to the Project is considered to be **Low**.

9.6 Impact Assessment and Evaluation

Potential Sources of Impacts

9.6.1 During the construction phase, landscape and visual impacts may result from the following:

- Minor site clearance works (from trimming of existing vegetation (shrubs, bamboo and herbs) for the construction of new Tower Hides 2 & 3 and new access paths)
- Building works
- Construction traffic
- Presence of construction machinery and equipment. temporary parking areas, construction storage, site offices and facilities of works areas
- Temporary works hoardings, barriers and enclosures
- Construction dust and waste materials

9.6.2 During the operational phase, landscape and visual impacts may result from the following:

- Operation of the new footpaths and Tower Hides 2 and 3
- Routine vegetation maintenance along the new access to Tower Hides 2 and 3
- Loss of visual amenity previously present at the Project Site

Landscape Impact Assessment

Construction Phase without Mitigation

9.6.3 The Project will have direct impacts on the following LRs and LCA:

- **LR3-1 Planting Surrounding Developed Area** due to upgrading of existing paved footpath (no net loss in any man-made features (e.g. paved foot-paths) and facilities in MPNR and no loss of existing trees)
- **LR2-1 Brackish Gei Wai** (~490m^2) and **LR2-2 Rain-fed Pond** (~170m^2) due to construction of the two new Tower Hides (TH2 and TH3) and the new access paths connecting the new THs
- **LCA4 Rural Coastal Plain Landscape: Mai Po Nature Reserve and Adjacent Ponds** within which the Project elements are located

9.6.4 Given the small-scale and limited footprints of the Project Elements and that no felling or pruning of existing trees is anticipated, the magnitude of change in all the affected LRs and LCA is considered to be **Small** (***Table 9-8***).During the construction phase (a short, temporary period), the Project is considered to result in **Moderate** impacts on **LR2-1** and **LR2-2** which are considered to be of **High** sensitivity; and only **Slight** impacts on **LR3-1** which is an already "developed area" having **Low** sensitivity. The overall construction phase impacts on **LCA4** with **Medium** sensitivity are considered to be **Slight**.

9.6.5 The Project is not considered to result in any noticeable changes to any off-site LRs or LCAs during the construction phase of the Project.

Operation Phase without Mitigation

9.6.6 The Project will result in permanent loss of small areas of **LR2-1** (~490m^2) and **LR2-2** (~170m^2), but no net loss of **LR3-1** (due to construction of new boardwalks above existing paved footpath). The magnitude of change in all affected LRs and **LCA4** is considered to be **Small**. During the operation phase for an unmitigated scenario, the Project is expected to result in **Moderate** severity of landscape impacts on **LR2-1** and **LR2-2** which are considered to have **High** sensitivity to developments. Only **Slight** landscape impacts on **LR3-1** are anticipated from the operation of the upgraded boardwalks which are a previously paved footpath. **LCA4** which is considered to have **Medium** sensitivity to low-rise/ small-scaled developments will experience **Slight** impacts from the operation of Project.

9.6.7 The Project is not considered to result in any noticeable changes to any off-site LRs or LCAs during the operation of Project. ***Table 9-9***, below, summarises the severity of landscape impacts during construction and operation phases of Project.

Visual Impact Assessment

Construction Phase without Mitigation

9.6.8 The magnitude of change in visual quality of the VSRs depends on a number of factors including compatibility of the Project with the surrounding visual environments, duration of impacts, scale of development, reversibility of change, viewing distance and blockage of view when the Project is in place. The Project is considered to have **Fair** compatibility with the surrounding environment given its small scale of development and the low level of blockage of existing view.

9.6.9 The field workers working at the pond bund near gei wai No. 20 (i.e. **F-3**) who can partially view the proposed TH2 and the new access connecting TH2 when coming close to these Project elements are expected to notice a **Medium** level of visual changes during the construction phase. **L-2** who are the visitors in MPNR are relatively more mobile and will notice **Small** to **Medium** level of visual changes when they travel along the visitor routes during Project construction, with most of their views being intermittently blocked by existing trees at intervals. These VSRs are expected to experience **Moderate** visual impacts at Project construction phase.

9.6.10 The remaining VSRs with **Low** sensitivity are expected to notice **Negligible** visual changes and experience **Insubstantial** impacts from the construction of Project.

Operation Phase without Mitigation

9.6.11 The VSRs **L-2** and **F-3** who are expected to notice **Small to Medium** level of visual changes are expected to experience **Moderate** visual impacts from the operation of the Project without mitigation. As in the construction phase, the remaining VSRs who are considered to have **Low** sensitivity are expected to experience only **Negligible** changes and **Insubstantial** visual impacts during operation of Project.

9.6.12 ***Table 9-10*** and ***Table 9-11***, below, summarise the severity of visual impacts during construction and operation phases of Project.

Table 9-8 Summary of Magnitude of Change in Landscape Resources (LRs) and Landscape Character Areas (LCAs) Before Mitigation

REF.	LANDSCAPE SENSITIVE RECEIVERS	COMPATIBILITY WITH SURROUNDINGS (GOOD/FAIR/POOR)		DURATION OF IMPACTS (LONG/MEDIUM/ SHORT/NIL)		SOURCE AND DESCRIPTION OF IMPACTS	REVERSIBILITY OF CHANGE		MAGNITUDE OF CHANGE (LARGE/MEDIUM/SMALL / NEGLIGIBLE)	
		CON	OP	CON	OP		CON	OP	CON	OP
LANDSCAPE RESOURCES (LRs)										
LR1-1	Mangrove	Good	Good	Nil	Nil	Nil	No	No	Negligible	Negligible
LR1-2	Brackish Marsh	Good	Good	Nil	Nil	Nil	No	No	Negligible	Negligible
LR1-3	Wooded Area	Good	Good	Nil	Nil	Nil	No	No	Negligible	Negligible
LR1-4	Reed	Good	Good	Nil	Nil	Nil	No	No	Negligible	Negligible
LR2-1	Brackish Gei Wai	Fair	Fair	Short	Short	Approximately 490m^2 area of Brackish Gei Wai will be lost due to construction of two new Tower Hides (TH2 and TH3) and the new access paths connecting the new THs.	No	No	Small	Small
LR2-2	Rain-fed Pond	Fair	Fair	Short	Short	Approximately 170m^2 area of Rain-fed Pond will be lost due to construction of two new Tower Hides (TH2 and TH3) and the new access paths connecting the new THs.	No	No	Small	Small
LR2-3	Commercial Fishpond	Good	Good	Nil	Nil	Nil	No	No	Negligible	Negligible
LR2-4	Channelised Watercourse	Good	Good	Nil	Nil	Nil	No	No	Negligible	Negligible
LR2-5	Watercourse	Good	Good	Nil	Nil	Nil	No	No	Negligible	Negligible
LR2-6	Buffalo Marsh	Good	Good	Nil	Nil	Nil	No	No	Negligible	Negligible
LR3-1	Developed Area	Good	Good	Short	Short	Upgrading of existing paved footpath will be conducted within LR3-1. This will involve conversion of the existing paved footpath into a new wooden boardwalk. There will be no net loss of any man-made features and facilities in MPNR and no net loss of existing trees.	No	No	Small	Small

REF.	LANDSCAPE SENSITIVE RECEIVERS	COMPATIBILITY WITH SURROUNDINGS (GOOD/FAIR/POOR)		DURATION OF IMPACTS (LONG/MEDIUM/ SHORT/NIL)		SOURCE AND DESCRIPTION OF IMPACTS	REVERSIBILITY OF CHANGE		MAGNITUDE OF CHANGE (LARGE/MEDIUM/SMALL / NEGLIGIBLE)	
		CON	OP	CON	OP		CON	OP	CON	OP
LANDSCAPE CHARACTER AREAS (LCAs)										
LCA1	Comprehensive Residential Development Area	Good	Good	Nil	Nil	Nil	No	No	Negligible	Negligible
LCA2	Inter-tidal Coast Landscape	Good	Good	Nil	Nil	Nil	No	No	Negligible	Negligible
LCA3	Offshore Water Landscape	Good	Good	Nil	Nil	Nil	No	No	Negligible	Negligible
LCA4	Rural Coastal Plain Landscape	Good	Good	Short	Short	The construction of new Tower Hides and upgrading of existing footpaths/ construction of new access linking these Tower Hides (i.e. the impacts on LR2-1, LR2-2 and LR3-1 as stated above) are all within LCA4.	No	No	Small	Small

Note: CON = construction phase, OP = operation phase.

Table 9-9 Summary of Significance of Landscape Impacts

REF.	LANDSCAPE SENSITIVE RECEIVERS	SENSITIVITY (HIGH/ MEDIUM/ LOW)	TOTAL AREA TO BE AFFECTED (m^2)	MAGNITUDE OF CHANGE (LARGE/MEDIUM/SMALL/ NEGLIGIBLE)		IMPACT SIGNIFICANCE THRESHOLD WITHOUT MITIGATION (SUBSTANTIAL/MODERATE/ SLIGHT/INSUBSTANTIAL)		MITIGATION MEASURES		RESIDUAL IMPACT SIGNIFICANCE THRESHOLD AFTER MITIGATION		
				CON	OP	CON	OP	CON	OP	CON	OP	
											DAY 1	YEAR 10
LANDSCAPE RESOURCES (LRs)												
LR1-1	Mangrove	High	-	Negligible	Negligible	Insubstantial	Insubstantial	-		Insubstantial	Insubstantial	Insubstantial
LR1-2	Brackish Marsh	High	-	Negligible	Negligible	Insubstantial	Insubstantial	-		Insubstantial	Insubstantial	Insubstantial
LR1-3	Wooded Area	Low	-	Negligible	Negligible	Insubstantial	Insubstantial	-		Insubstantial	Insubstantial	Insubstantial
LR1-4	Reed	Medium	-	Negligible	Negligible	Insubstantial	Insubstantial	-		Insubstantial	Insubstantial	Insubstantial
LR2-1	Brackish Gei Wai	High	490	Small	Small	Moderate	Moderate	CM1, CM2 CM3, CM4	OM1, OM2	Slight (Acceptable with Mitigation)	Slight (Acceptable with Mitigation)	Slight (Acceptable with Mitigation)
LR2-2	Rain-fed Pond	High	170	Small	Small	Moderate	Moderate	CM1, CM2 CM3, CM4	OM1, OM2	Slight (Acceptable with Mitigation)	Slight (Acceptable with Mitigation)	Slight (Acceptable with Mitigation)
LR2-3	Commercial Fishpond	Medium	-	Negligible	Negligible	Insubstantial	Insubstantial	-		Insubstantial	Insubstantial	Insubstantial
LR2-4	Channelised Watercourse	Low	-	Negligible	Negligible	Insubstantial	Insubstantial	-		Insubstantial	Insubstantial	Insubstantial
LR2-5	Watercourse	Medium	-	Negligible	Negligible	Insubstantial	Insubstantial	-		Insubstantial	Insubstantial	Insubstantial
LR2-6	Buffalo Marsh	Low	-	Negligible	Negligible	Insubstantial	Insubstantial	-		Insubstantial	Insubstantial	Insubstantial
LR3-1	Developed Area	Low	Nil (No net loss)	Small	Small	Slight	Slight	CM1, CM2 CM3, CM4	OM1	Insubstantial (Acceptable with Mitigation)	Slight (Beneficial with Mitigation)	Slight (Beneficial with Mitigation)

REF.	LANDSCAPE SENSITIVE RECEIVERS	SENSITIVITY (HIGH/ MEDIUM/ LOW)	TOTAL AREA TO BE AFFECTED (m^2)	MAGNITUDE OF CHANGE (LARGE/MEDIUM/SMALL/ NEGLIGIBLE)		IMPACT SIGNIFICANCE THRESHOLD WITHOUT MITIGATION (SUBSTANTIAL/MODERATE/ SLIGHT/INSUBSTANTIAL)		MITIGATION MEASURES		RESIDUAL IMPACT SIGNIFICANCE THRESHOLD AFTER MITIGATION		
											OP	
				CON	OP	CON	OP	CON	OP	CON	DAY 1	YEAR 10
LANDSCAPE CHARACTER AREA (LCAs)												
LCA1	Comprehensive Residential Develop. Area	Low	-	Negligible	Negligible	Insubstantial	Insubstantial	-		Insubstantial	Insubstantial	Insubstantial
LCA2	Inter-tidal Coast Landscape	High	-	Negligible	Negligible	Insubstantial	Insubstantial	-		Insubstantial	Insubstantial	Insubstantial
LCA3	Offshore Water Landscape	N/A	-	Negligible	Negligible	Insubstantial	Insubstantial	-		Insubstantial	Insubstantial	Insubstantial
LCA4	Rural Coastal Plain Landscape	Medium	660	Small	Small	Slight	Slight	CM1, CM2 CM3, CM4	OM1, OM2	Insubstantial (Acceptable with Mitigation)	Insubstantial (Acceptable with Mitigation)	Insubstantial (Acceptable with Mitigation)

Note: CON = construction phase, OP = operation phase.

Table 9-10 Summary of Magnitude of Change in Visual Quality of VSRs Before Mitigation

VSR NO.	LOCATION	COMPATIBILITY WITH SURROUNDINGS (GOOD/FAIR/ POOR)		DURATION OF IMPACTS (LONG/MEDIUM /SHORT/NIL)		SCALE OF DEVELOPMENT (LARGE/ MEDIUM/ SMALL)	REVERSIBILITY OF CHANGE (YES/ NO)		THE SHORTEST VIEWING DISTANCE (m)	POTENTIAL BLOCKAGE OF VIEW (HIGH/MEDIUM/ LOW)		MAGNITUDE OF CHANGE (LARGE/MEDIUM/SMALL /NEGLIGIBLE)	
		CON	OP	CON	OP		CON	OP		CON	OP	CON	OP
FUNCTIONAL VSRs													
F-1	Commercial Fishpond	Fair	Good	Short	Long	Small	No	No	0	Low	Low	Negligible	Negligible
F-2	MPEC	Fair	Good	Short	Long	Small	No	No	0	Low	Low	Negligible	Negligible
F-3	Along Pond Bund of MPNR (near Pond No.20)	Poor	Good	Short	Long	Small	No	No	0	Low	Low	Medium	Medium
LEISURE VSRs													
L-1	Visitors outside the Entrance of MPNR	Fair	Good	Short	Long	Small	No	No	0	Low	Low	Negligible	Negligible
L-2	Visitors in MPNR along the boardwalk	Fair	Good	Short	Long	Small	No	No	0	Low	Low	Small to Medium	Small to Medium
L-3	Visitors in Main Tower Hide (TH1)	Fair	Good	Short	Long	Small	No	No	0	Low	Low	Negligible	Negligible
RESIDENTIAL VSRs													
R-1	Villagers next to the Entrance of MPNR	Fair	Good	Short	Long	Small	No	No	23	Low	Low	Negligible	Negligible

Note: CON = construction phase, OP = operation phase.

Table 9-11 Summary of Significance of Visual Impacts after Mitigation

VSR NO.	LOCATION	SENSITIVITY (HIGH/MEDIUM/ LOW)		MAGNITUDE OF CHANGE (LARGE/MEDIUM/ SMALL/NEGLIGIBLE)		IMPACT SIGNIFICANCE THRESHOLD WITHOUT MITIGATION (SUBSTANTIAL/MODERATE/ SLIGHT/INSUBSTANTIAL)		MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE THRESHOLD AFTER MITIGATION		
		CON	OP	CON	OP	CON	OP		CON	OP	
										DAY 1	YEAR 10
FUNCTIONAL VSRs											
F-1	Commercial Fishpond	Low	Low	Negligible	Negligible	Insubstantial	Insubstantial	-	Insubstantial	Insubstantial	Insubstantial
F-2	MPEC	Low	Low	Negligible	Negligible	Insubstantial	Insubstantial	-	Insubstantial	Insubstantial	Insubstantial
F-3	Along Pond Bund of MPNR (near gei wai No.20)	Medium	Medium	Medium	Medium	Moderate	Moderate	CM2, CM3, CM4, OM1, OM2	Slight (Acceptable with Mitigation)	Slight (Acceptable with Mitigation)	Slight (Acceptable with Mitigation)
LEISURE VSRs											
L-1	Visitors outside the Entrance of MPNR	Low	Low	Negligible	Negligible	Insubstantial	Insubstantial	-	Insubstantial	Insubstantial (Beneficial)	Insubstantial (Beneficial)
L-2	Visitors to MPNR along the boardwalk	Medium	Medium	Small to Medium	Small to Medium	Moderate	Moderate	CM2, CM3, CM4, OM1, OM2	Slight (Acceptable with Mitigation)	Slight (Acceptable with Mitigaiton)	Slight (Acceptable with Mitigation)
L-3	Visitors in Main Tower Hide (TH1)	Low	Low	Negligible	Negligible	Insubstantial	Insubstantial	-	Insubstantial	Insubstantial	Insubstantial
RESIDENTIAL VSRs											
R-1	Villagers next to the Entrance of MPNR	Low	Low	Negligible	Negligible	Insubstantial	Insubstantial	-	Insubstantial	Insubstantial (Beneficial)	Insubstantial (Beneficial)

Note: CON = construction phase, OP = operation phase.

9.7 Mitigation/Enhancement Measures

9.7.1 The Project itself is considered to enhance the landscape/visual quality of the existing footpath overall through conversion of a hard-paved path into natural-looking wooden boardwalks. However, the Project also introduces new features (i.e. the new Tower Hides TH2 & TH3 and new access paths connecting the new THs) with surface treatment suitable to a rural context.

9.7.2 The following types of mitigation/ enhancement measures or good site practice will be implemented to avoid/ minimize potential construction impacts and enhance overall landscape/ visual quality of the site during Project operation:

9.7.3 Parties shall be identified for the ongoing management and maintenance of the proposed mitigation works to ensure their effectiveness throughout the construction phase and operational phase of the Project. Agreement from relevant authorities responsible for funding, implementation, management and maintenance of proposed mitigation measures have to be obtained before including into the LVIA. A practical programme for the implementation of the recommended measures shall be provided

9.7.4 During construction, the following mitigation measures/good site practice shall be implemented, managed and maintained by the Contractor, who shall be supervised by the Engineer. These mitigation measures will be included in the Contractor’s construction programme, which shall be approved by the Engineer:

- **CM1:** No night-time lighting
- **CM2:** Preservation and protection of existing trees and vegetation
- **CM3:** Arrangement of the storage of materials
- **CM4:** Erection of screen hoarding for new Tower Hides (TH2 and TH3) with surface colour treatment suitable for a rural context

9.7.5 During operation, the following mitigation measures will be funded, implemented, managed and maintained by the Project Proponent as part of the ongoing MPNR maintenance programme:

- **OM1:** Suitable design of the proposed footpaths and bird-watching hides:
  - Use of wooden boardwalks to fit in with the surrounding natural landscapes
  - natural colour and non-reflective materials shall be used for the building façades of the new Tower Hides
- **OM2:** Screen planting at the access to the new Tower Hides:
  - bamboo shall be used for screening, proposed bamboo species is *Bambusa tuldoides* (青稈竹, 花眉竹)

9.7.6 To illustrate the predicted effectiveness of the proposed landscape/ visual mitigation measures during operation of the Project, a series of photomontages (***Figure 9-8***) have been prepared at representative viewpoint locations (***Figure 9-7***) to provide comparison between the existing views, proposals on Day 1 of operation without mitigation, on Day 1 after mitigation, and in Year 10 after mitigation. The locations and details of proposed mitigation measures to mitigate operation phase impacts are displayed in ***Figure 9-9***.

Photomontage for Key Viewpoint VP01

9.7.7 The viewpoint VP01 represents a view from VSRs just outside the entrance of MPNR, including the visitors of MPNR (**L-1**) and the nearby villagers (**R-1**) just passing by the entrance who can both view a tiny portion of the proposed footpaths. These VSRs are expected to notice negligible changes due to the conversion of the hard paved footpath into wooden boardwalks. With the responsive design of the new footpaths, the overall visual impacts on these VSRs are considered to be **Acceptable** and potentially **Beneficial**.

Photomontage for Key Viewpoint VP02

9.7.8 The viewpoint VP02 represents a typical view from the workers of commercial fishponds (i.e. **F-1**). Although **F-1** can walk along the pond bund immediately linked with the existing visitor route proposed for the new footpaths, it is expected that **F-2** are more frequently working between the fishponds at considerable distances from the new footpaths. As illustrated with the photomontage, **F-2** will notice negligible changes due to the construction of new footpaths which are located at ground level and to be screened off by existing vegetation. The visual impacts on **F-2** are considered **Insubstantial** in the absence of mitigation, and **Acceptable** during construction and operation of Project when mitigation measures are implemented.

Photomontage for Key Viewpoint VP03

9.7.9 The viewpoint VP03 represents a typical view seen by visitors who are bird-watching in the existing Tower Hide (TH1)(i.e. **L-3**) when looking towards the location of the proposed TH3. As shown in the photomontage, the proposed TH3 is located some 100m from **L-3** who are expected to notice negligible changes due to the Project when these VSRs are concentrating on their bird-watching activities. The overall visual impacts on **L-3** are considered to be **Insubstantial** without mitigation, and **Acceptable** when mitigation measures are implemented.

Photomontage for Key Viewpoint VP04

9.7.10 The viewpoint VP04 represents a typical view from visitors of MPNR (**L-2**) and staff of MPEC (**F-2**) who travel to work at the entrance of MPEC and be able to view a small portion of the new footpaths. As shown in the photomontage, the finishes of the new footpaths appear to fit in well with the existing natural environments. These VSRs are expected to notice negligible visual changes with the responsive design of the new footpaths.

Photomontage for Key Viewpoint VP05

9.7.11 The viewpoint VP05 represents a view the workers along the pond bund of MPNR near gei wai No. 20 (i.e. (**F-3**) who can view the proposed new access path connecting the proposed Tower Hide TH2 when they come close to the Project elements. **F-3** are expected to notice a **Medium** level of visual changes and experience **Moderate** impacts from the construction of the new access without mitigation (in the absence of screen planting). As illustrated in the photomontages Day 1 and Year 10 of project operation, the view of the new access path will be significantly softened and screened off by proposed bamboo planting on both sides of the path. The overall visual impacts on **F-3** are considered to be **Acceptable** when mitigation measures are in place.

Photomontage for Key Viewpoints VP06 and VP07

9.7.12 The viewpoints VP06 and VP07 represent medium to long ranged views from distant viewers who can be occasional visitors or staff of MPNR. As illustrated in the photomontages, the viewers are not expected to perceive any noticeable visual changes as a result of the Project.

9.7.13 The severity of visual impacts after implementation of mitigation measures are summarised in ***Table 9-9*** and ***Table 9-10***, above.

9.8 Residual Impacts

9.8.1 With full implementation of the mitigation/enhancement measures as detailed above, no adverse residual impacts are anticipated from the construction and operation of the Project. All the residual landscape and visual impacts from the upgrading of existing facilities due to the Project are considered to be **Acceptable**, and potentially **Beneficial.**

9.9 Cumulative Impacts

9.9.1 The demolition and rebuild of PSFSC near MPNR will have been completed by March 2022 whereas the construction of this Project will commence at end-April 2022. As such, the demolition and rebuild of PSFSC will not be carried out concurrently with this Project. There are

also no other concurrent projects near MPNR. Thus, cumulative landscape and visual impacts for this Project is not anticipated.

9.9.2 As shown in the Project Programme in ***Figure 2-6***, there are also no concurrent works related to the *MPNR Management Plan 2019-2024* and so no cumulative landscape and visual impacts.

9.10 Environmental Monitoring and Audit

9.10.1 Implementation of the recommended landscape and visual mitigation measures described in ***Section 9.7*** should be conducted in accordance with the standalone Environmental Monitoring and Audit (EM&A) Manual. Key components of EM&A requirements are summarised as follows:

- Baseline monitoring of conditions of LRs and LCAs prior to start of construction works.
- Regular site inspection and audit during the construction phase to ensure proper implementation of mitigation measures/ good site practice to minimize or mitigate potential landscape and visual impacts.
- The extent of works areas should be regularly checked by the Environmental Team (ET) to ensure no damage to existing vegetation or trees outside the works limits.
- Implementation of bamboo screen planting (at TH2 and TH3) and subsequent maintenance for an establishment period over 36 months.
- The conditions and growth performance of the implemented bamboo screen plantings should be regularly checked and monitored by a qualified plant specialist of the ET to ensure the effectiveness of the mitigation measures.

9.11 Conclusion

9.11.1 Based on the assessment, the Project will result in loss of small areas of natural landscape resources (i.e. **LR2-1** *Brackish gei wai* (bund, not water area) and **LR2-2** *Rain-fed Pond* (bund, not water area)) due to the construction of new tower hides and new access connecting the new tower hides. There will be no net loss of **LR3-1** *Developed Area* due to the proposed new boardwalk. The Project is considered to result in only **Small** changes in the affected LRs and **LCA4** *Rural Coastal Plain Landscape* within which the Project elements are located. The resulting construction and operational phase impacts on the affected LRs/ LCA4 range from **Slight** (**LR3-1** and **LCA4**) to **Moderate** (**LR2-1** and **LR2-2**) without mitigation.

9.11.2 The Project is considered to have **Fair** compatibility with the surrounding environments given its small scale/ limited footprints of development and low level of blockage of existing view that may arise. Most of the VSRs who are considered to have **Low** sensitivity will only notice **Negligible** changes and experience **Insubstantial** visual impacts from the construction and operation of the Project. However, there are some VSRs including the visitors in MPNR (**L-2**) and workers along the pond bund near Pond No. 20 (**F-3**) who can view different portions the Project elements and will notice **Small to Medium** level of visual changes during construction and/or operation of the Project. The resulting visual impacts on **L-2** and **F-3** are expected to be **Moderate** without mitigation.

9.11.3 With full implementation of the mitigation measures as recommended in ***Section 9.7*** including responsive design of the new Tower Hides and footpaths, and implementation of bamboo screen plantings at the new Tower Hides, the overall landscape and visual impacts resulting from the construction and operation of Project are all considered to be **Acceptable**, and some of the receivers (e.g. **LR3-1** Developed Area, and the VSRs **L-1** and **R-1** located outside the entrance of MPNR) may experience potentially **Beneficial** impacts from new boardwalk that is more aesthetically compatible with the surrounding natural landscapes.

9.11.4 The Project is not anticipated to result in any cumulative impacts from concurrent projects as there are no concurrent projects in the 500m Assessment Area.In conclusion, any potential landscape and visual impacts arising from the construction and operation of the Project are all considered to be **Acceptable** when appropriate mitigation measures are implemented.

10 ENVIRONMENTAL MONITORING AND AUDIT (EM&A) REQUIREMENTS

10.1 Introduction

10.1.1 An EM&A programme is proposed to ensure compliance with the recommendations in the EIA study to assess the effectiveness of the recommended mitigation measures and to identify any further need for additional mitigation measures or remedial action.

10.1.2 In addition to the Project Proponent (as the Employer's Representative) and the Construction Contractor, the EM&A programme also requires the participation of an Environmental Team (ET) and an Independent Environmental Checker (IEC), both of whom shall be engaged by the Project Proponent.

10.1.3 Full details of the EM&A programme, the monitoring requirements, site inspection/audit requirements, and the primary responsibilities and duties of the key EM&A programme participants are provided in ***Volume IV: EM&A Manual*** for the Project. The following sections summarise these requirements:

10.2 Air Quality

10.2.1 Air quality impacts were assessed in ***Chapter 3***. Based on the assessment results, and with the implementation of the recommended dust suppression measures, no adverse air quality impact from the Project is anticipated at off-site ASRs during construction. No air quality monitoring is therefore deemed necessary. Nevertheless, regular site environmental audit is recommended to ensure the implementation of the recommended mitigation measures.

10.2.2 Regular inspection and audit of each works area shall be conducted during the construction phase of the Project to ensure the recommended mitigation measures are properly implemented. When there are ongoing construction works within the Project Site, the ET shall carry out inspections once per week and the IEC shall carry out audits jointly with the ET once every two weeks.

10.2.3 Inspection findings shall be logged in a site monitoring report with any discrepancies or concerns regarding the implementation and effectiveness of mitigation measures highlighted.

10.2.4 Mitigation measures to prevent construction phase dust impacts have been recommended in ***Section 3.7***. All the recommended mitigation measures are detailed in the implementation schedule in ***Appendix E***. Appropriate parties have been identified to be responsible for the design and implementation of these mitigation measures.

10.3 Noise

10.3.1 Noise impacts were assessed in ***Chapter 4***. Based on the assessment results, and with the implementation of recommended noise control measures, no adverse noise impact from the Project is anticipated at off-site NSRs during construction. No noise monitoring is therefore deemed necessary for NSRs. Nevertheless, regular site environmental audit is recommended to ensure the implementation of the recommended mitigation measures.

10.3.2 Regular inspection and audit of each works area shall be conducted during the construction phase of the Project to ensure the recommended mitigation measures are properly implemented. When there are ongoing construction works within the Project Site, the ET shall carry out inspections once per week and the IEC shall carry out audits jointly with the ET once every two weeks.

10.3.3 Inspection findings shall be logged in a site monitoring report with any discrepancies or concerns regarding the implementation and effectiveness of mitigation measures highlighted.

10.3.4 Mitigation measures to prevent construction phase noise impacts have been recommended in ***Section 4.9***. All the recommended mitigation measures are detailed in the implementation

schedule in ***Appendix E***. Appropriate parties have been identified to be responsible for the design and implementation of these mitigation measures.

10.4 Water Quality

10.4.1 Water quality impacts were assessed in ***Chapter 5*** and identified that Deep Bay, the gei wai, Shan Pui Rivier, commercial fishponds and SSSIs adjacent to and within the Site and the natural watercourses running through the Assessment Area as Water Sensitive Receivers (WSRs). ***Paragraph 5.4.12-5.4.29*** therefore recommended a series of stringent mitigation measures to be implemented at each works site to ensure that no contaminated run-off enters the fishponds or gei wai, and from there potentially into Deep Bay.

10.4.2 With the implementation of water pollution control measures no adverse water quality impact from the Project is anticipated during construction. Nevertheless, as a precautionary measure and to demonstrate that the "Zero Water Pollution" approach is working, it is proposed to carry out water quality EM&A before, during and (if required) after the foundation works at TH2 and TH3.

Monitoring

Parameters, Equipment and Analysis

10.4.3 The following parameters are related to construction activity:

- Water depth – to be measured in-situ
- pH – to be measured in-situ
- Temperature in ^{o}C – to be measured in-situ
- Salinity in mg/L – to be measured in-situ
- Turbidity in NTU – to be measured in-situ
- Dissolved Oxygen (DO) in % saturation and mg/L – to be measured in-situ
- Suspended Solids (SS) in mg/L – to be determined in a laboratory
- Oil and Grease (O&G) in mg/L – to be determined in a laboratory

10.4.4 Equipment provided by the ET to measure the above parameters shall include:

- Portable, battery-operated echo sounder shall be used for the determination of water depth at each designated monitoring station.
- Portable pH Meter, which shall be checked, calibrated and certified before use by a HOKLAS laboratory.
- DO and Temperature Measuring Equipment capable of measuring DO in the range of 0 to 20 mg/L and 0 to 200% saturation and measuring temperate of 0-45°C, which shall be checked, calibrated.
- Portable salinometer capable of measuring salinity in the range of 0-40 mg/l shall be provided for measuring salinity of the water and certified before use by a HOKLAS laboratory.
- Turbidity Measurement Equipment capable of measuring turbidity between 0-1000 NTU and certified before use by a HOKLAS laboratory.
- A high density 1L capacity polythene bottle shall be used to collect a water sample from just below the water surface for SS measurements while water sample for O&G measurement shall be collected in glass bottles and preserved by addition of H_2SO_4. At least two replicate samples should be collected from each location. After fully filling the bottles, they shall be cooled to 4°C without being frozen.

10.4.5 All in-situ monitoring equipment shall be checked, calibrated and certified by a laboratory accredited under HOKLAS or any other international accreditation scheme before use, and subsequently re-calibrated at 3 monthly intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes shall be checked with certified standard solutions before each use. Wet bulb calibration for a DO meter shall be carried out before measurement at each monitoring location.

10.4.6 The water samples shall be delivered to a HOKLAS laboratory as soon as possible for analysis, which shall start the next working day after collection of samples. Analyses shall follow standard methods as described in *APHA Standard Methods for the Examination of Water and Wastewater, 19th Edition*, unless otherwise specified (APHA 2540D for SS and APHA 5520C for O&G). The submitted information should include pre-treatment procedures, instrument use, Quality Assurance/Quality Control (QA/QC) details (such as blank, spike recovery, number of duplicate samples per-batch, etc.), detection limits and accuracy. The QA/QC details shall be in accordance with requirements of HOKLAS.

10.4.7 In addition to the water quality parameters, other relevant data should also be measured and recorded in field logs, including coordinates of the sampling stations, the location of construction works at the time of sampling, sampling depth, weather conditions, special phenomena and work activities undertaken around the monitoring and works area that may influence the monitoring results, etc.

Monitoring Locations

10.4.8 Monitoring shall be carried out adjacent to the sluice gates connecting MPNR to Deep Bay that are closest to the tower hides works areas, i.e. Sluice Gate 7 (closest to TH3) and Sluice Gate 19 (closest to TH2). Sluice Gate 7 and Sluice Gate 19 are the only connection of Gei Wai 7 and Gei Wai 19 to Deep Bay. These locations are show ***Figure 10-1***. Samples to be taken at the sluice gate shall be at the depth of 1m below water surface. For stations with a water depth of less than 1m, monitoring shall be carried out at the mid-depth. Water sampling shall not be taken if water depth is less than 0.25m.

Baseline Monitoring

10.4.9 Baseline water quality monitoring at Sluice Gate 7 and Sluice Gate 19 shall be carried out three times per week, with a minimum interval of 36 hours, for a period of four weeks prior to the commencement of foundation works at TH2 and TH3. EPD shall be advised two weeks prior to the start of baseline monitoring. A *Baseline Monitoring Report* shall be prepared by the ET, verified by the IEC and then submitted to EPD within two weeks after completion of monitoring. Baseline conditions for water quality shall be established and agreed with DEP prior to the commencement of works.

Precautionary Monitoring

10.4.10 Precautionary water quality monitoring at Sluice Gate 7 and Sluice Gate 19 shall be carried out three times per week, with a minimum interval of 36 hours, when foundation works are carried out at TH2 and TH3. Each month that foundation works are carried out at TH2 and TH3, a *Monthly EM&A Report* shall be prepared by the ET, verified by the IEC and then submitted to EPD within two weeks after the end of the month.

Post-construction Monitoring (if Needed)

10.4.11 If, at the completion of foundation works, the final week of precautionary monitoring shows more than two consecutive exceedances of Action and/or Limit Levels attributable to the Project, then post-construction monitoring at Sluice Gate 7 and/or Sluice Gate 19 (as needed) shall be carried out three times per week until readings return to baseline levels. On completion of post-construction monitoring, a *Final Summary EM&A Report* will be prepared by ET, verified by the IEC and then submitted to EPD within two weeks after completion of monitoring.

Action and Limit Levels and Event/Action Plan for Precautionary Monitoring

10.4.12 Precautionary monitoring results shall be evaluated against Action and Limit levels shown in ***Table 10-1***, below, with action being taken as per the Event/Action Plan shown in ***Table 10-2***, also below. Please note that the Event/Action Plan relates only to exceedances that are directly attributable to the construction works of this Project, over which the installation contractor has control. The advice of the IEC shall be sought in case of any concern.

Table 10-1 Action and Limit Levels for Water Quality

PARAMETER	ACTION LEVEL	LIMIT LEVEL
DO in mg/L	5th percentile of baseline data	1st percentile of baseline data
SS in mg/L	95th percentile of baseline data	99th percentile of baseline data
Turbidity in NTU	95th percentile of baseline data	99th percentile of baseline data

Table 10-2 Event / Action Plan for Water Quality

EVENT	CONTRACTOR / ET	IEC	ER
Action Level Exceedance	1. Repeat sampling event. 2. Inform EPD and AFCD and confirm notification of the non-compliance in writing. 3. Discuss with contractor and the IEC the most appropriate method of reducing water quality pollution during construction and agree with EPD. 4. Repeat measurements after implementation of mitigation for confirmation of compliance. 5. If non-compliance continues, increase measures in Step 3 and repeat measurement in Step 4. If non-compliance occurs a third time, suspend construction works and continue sampling until normal water quality resumes.	1. Discuss with Contractor/ET on the mitigation measures 2. Review proposals on mitigation measures submitted by Contractor and advise the ER accordingly 3. Assess the effectiveness of the implemented mitigation measures.	1. Discuss with IEC on the proposed mitigation measures; 2. Make agreement on the mitigation measures to be implemented; 3. Assess the effectiveness of the implemented mitigation measures.
Limit Level Exceedance	Suspend construction works and undertake Steps 1-4 immediately. Construction works should only continue when the water quality shows compliance again.	Undertake Steps 1-3 immediately.	Undertake Steps 1-3 immediately and consider and instruct, if necessary, the Contractor to slow down or to stop all or part of the marine work until no exceedance of Limit level.

Audit

10.4.13 Regular inspection and audit of each works area shall be conducted during the construction phase of the Project to ensure the recommended mitigation measures are properly implemented. When there are ongoing construction works within the Project Site, the ET shall carry out inspections once per week and the IEC shall carry out audits jointly with the ET once every two weeks.

10.4.14 Inspection findings shall be logged in a site monitoring report with any discrepancies or concerns regarding the implementation and effectiveness of mitigation measures highlighted.

10.4.15 Mitigation measures to prevent construction phase water quality impacts have been recommended in ***Section 5.6***. All the recommended mitigation measures are detailed in the implementation schedule in ***Appendix E***. Appropriate parties have been identified to be responsible for the design and implementation of these mitigation measures.

10.5 Waste Management

10.5.1 Waste Management impacts were assessed in ***Chapter 6***. Based on the assessment results, and with the proper handling, storage and disposal of wastes arising from the construction of the Project, it is anticipated that the potential adverse environmental impacts relating to waste would be avoided or minimised.

10.5.2 Measures to address potential waste management implications have been recommended in ***Section 6.6***. All the recommended mitigation measures are detailed in the implementation schedule in ***Appendix E***. Appropriate parties have been identified to be responsible for the design and implementation of these mitigation measures. When there are ongoing construction works within the Project Site, the ET shall carry out inspections once per week and the IEC shall carry out audits jointly with the ET once every two weeks.

10.5.3 The Contractor should submit a WMP prior to the commencement of construction work, in accordance with ETWB TC(W) No 19/2005 to provide an overall framework of waste management and reduction.

10.6 Ecology

10.6.1 Ecological impacts were assessed in ***Chapter 7***. Based on the assessment results, and with the implementation of the recommended measures to minimise potential direct and indirect impacts to ecological resources, no unacceptable ecological impact is anticipated.

10.6.2 Regular inspection and audit of each works area shall be conducted both prior to and during the construction phase of the Project to ensure the recommended mitigation measures are properly implemented. This should include checking that construction activity associated with TH2 has completed two hours before sunset.

10.6.3 When there are ongoing construction works within the Project Site, the ET shall carry out inspections once per week and the IEC shall carry out audits jointly with the ET once every two weeks.

10.6.4 Inspection findings shall be logged in a site monitoring report with any discrepancies or concerns regarding the implementation and effectiveness of mitigation measures highlighted.

10.6.5 Measures to address potential ecological impacts have been recommended in Section 7.9. All the recommended mitigation measures are detailed in the implementation schedule in ***Appendix E***. Appropriate parties have been identified to be responsible for the design and implementation of these mitigation measures.

10.7 Fisheries

10.7.1 Fisheries impacts were assessed in ***Chapter 8***. Based on the assessment results, no adverse fisheries impact from the Project is anticipated.

10.7.2 Regular inspection and audit of each works area adjacent to fishponds shall be conducted during the construction phase of the Project. When there are ongoing construction works within the Project Site, the ET shall carry out inspections once per week and the IEC shall carry out audits jointly with the ET once every two weeks.

10.7.3 Inspection findings shall be logged in a site monitoring report with any discrepancies or concerns regarding the implementation and effectiveness of mitigation measures highlighted.

10.8 Landscape and Visual

10.8.1 Landscape and visual impacts were assessed in ***Chapter 9***. Based on the assessment results, and with the implementation of recommended mitigation measures, no unacceptable landscape and visual from the Project is anticipated during construction.

Baseline Monitoring

10.8.2 Prior to the commencement of construction works, a *Baseline Landscape and Visual Report* shall be prepared to check, record and report the status of the Landscape Resources (LRs) and Landscape Character Areas (LCAs) within the works areas and the Visually Sensitive Receivers (VSRs) within the visual envelope. The Landscape and Visual Impact Assessment (LVIA) in the EIA Report may be used to formulate the *Baseline Monitoring Report* provided that there have been no significant changes to the status of LRs, LCAs and VSRs since the approval of the EIA Report.

10.8.3 If there have been significant changes to the status of LRs, LCAs and VSRs since the approval of the EIA Report, the recommended landscape and visual mitigation measures should be reviewed to determine if such changes warrant a change in the design of the landscape and visual mitigation measures.

Audit

10.8.4 Regular inspection and audit of each works area shall be conducted during the construction phase of the Project to ensure that proposed landscape and visual mitigation measures are properly implemented and maintained as per their intended objectives. When there are ongoing construction works within the Project Site, the ET shall carry out inspections once per week and the IEC shall carry out audits jointly with the ET once every two weeks.

10.8.5 In addition to regular monitoring and audit of each works area, the required screen planting of bamboos at TH2 and TH3 shall be inspected and audited on a monthly basis for the first twelve months after planting; on a bi-monthly basis during the second twelve months (months 13 to 24 inclusive); and on a quarterly basis for the third twelve months (months 25 to 36 inclusive).

10.8.6 Inspection findings shall be logged in a site monitoring report with any discrepancies or concerns regarding the implementation and effectiveness of mitigation measures highlighted.

10.8.7 Measures to address potential landscape and visual impacts have been recommended in ***Section 9.7***. All the recommended mitigation measures are detailed in the implementation schedule in ***Appendix E***. Appropriate parties have been identified to be responsible for the design and implementation of these mitigation measures.

11 SUMMARY OF INFORMATION

11.1 Summary of Environmental Outcomes

11.1.1 ***Chapter 2*** outlines the details and benefit of the Project together with the consideration of alternatives during the preliminary design stage, in which has taken into account of public concern and findings of various engineering and environmental reviews. All of the options considered have ensured that environmental impacts could be avoided or minimised where practicable and mitigated, as needed, by implementing suitable measures to fulfil all the statutory requirements.

11.1.2 The technical assessments in ***Chapters 3 to 9*** have demonstrated compliance with all statutory requirements in the EIA Study Brief (ESB-301/2017) and the EIAO-TM.

11.1.3 This section summarises the key environmental outcomes arising from this EIA study, the estimated population protected from various environmental impacts, environmentally sensitive areas protected, environmentally friendly options considered and incorporated in the preferred option, environmental designs recommended, key environmental problems avoided, compensation areas included and the environmental benefits of environmental protection measures recommended.

Estimated Population Protected

11.1.4 Due to the remote location of the Project there is a relatively low resident population in the vicinity. The environmental impacts resulting from the Project are minimal and no unacceptable impacts on surrounding populations are predicted. There is no population that requires "protection" due to this Project.

Environmentally Sensitive Areas Protected

11.1.5 The whole of the Project Site is an environmentally sensitive area – the Mai Po Nature Reserve – as is the area surrounding the Project Site. It has been a fundamental requirement for the Project Proponent that full protection to the unique ecology of MPNR is provided at all times throughout the construction and operation of the Project.

11.1.6 The design decisions that have been made, the construction methodologies employed and the EM&A programme that will be followed are all focused on avoiding or minimising impacts to the ecologically sensitive MPNR and surrounding areas and to the fauna and flora contained therein. As indicated in the ***Chapter 7***, no adverse ecological impacts are predicted to result from the construction and operation of the Project.

Environmentally Friendly Options and Designs

11.1.7 As described in ***Section 11.4***, below, a number of environmentally friendly options and environmental designs were considered and have been incorporated into the preferred design. These can be summarised as follows:

- Use of off-site pre-fabricated building elements for TH2 and TH3 to avoid the need for construction on-site – the works on site will be predominantly assembly of pre-fabricated components.
- Concrete will be mixed off-site and brought into each works area only when needed and only in the quantities required, so that there is no need to store (or dispose of) any surplus concrete.
- The existing concrete footpaths will be widened by construction of new boardwalks above the existing paths and does not require the existing concrete to be removed – this will remain in situ and untouched.

Key Environmental Problems Avoided

11.1.8 The key environmental problems that have been avoided in the preferred design can be summarised as follows:

- Choosing to construct TH3 rather than expand TH1 avoids root damage (possibly resulting in its death) to an adjacent large tree from foundations works associated with the TH1 expansion.
- Choosing not to construct the Circular Route avoids loss of mangrove and also avoids potential loss of wetland habitat due to the physical presence of supporting posts in the gei wai.
- Leaving the existing concrete footpaths in situ and untouched avoids the dust and noise impacts associated with concrete breaking. Furthermore, there will be no concrete waste to remove from site, which also reduces environmental impacts associated with the handling and transportation off-site of this waste.
- Off-site pre-fabrication of building elements for the two tower hides means that only assembly is required on site and the typical dust impacts associated building construction are avoided.
- Mixing concrete off-site avoids the potential for runoff contaminated by cement fines and concrete washings entering the gei wai adjacent to works areas. It also avoids the noise impacts associated with concrete mixing.
- Off-site maintenance/repair of plant avoids potential for runoff contaminated with resulting oil, chemical waste or other polluting substances entering the gei wai adjacent to works areas.

Compensation Areas

11.1.9 No compensation areas have been proposed or are included in the Project.

Environmental Benefits of Environmental Protection Measures

11.1.10 The environmental benefits of the environmental protection measures recommended can be summarised as follows:

- **Air Quality.** Fugitive dust emission is reduced by regular watering of exposed site surfaces and unpaved roads; by avoiding or covering open stockpiles; by enclosing any aggregate or dusty material storage piles or else spraying them with water; by using tarpaulin to cover dusty vehicle loads; by using water sprinklers in material loading areas; and by imposing speed controls for vehicles within the Site.
- **Noise.** There are no unacceptable noise impacts at off-site NSRs. Noise impacts on wildlife will be avoided or minimised by employing off-site pre-fabrication of building elements for TH2 and TH3; by keeping PME to a minimum and avoiding the parallel use of noisy equipment/machinery; turning off unused equipment; and by regular maintenance (off-site) of all plant and equipment.
- **Water Quality.** During construction, zero contaminated runoff from works areas will be achieved by programming the construction of footings/substructure at TH2 and TH3 only when the adjacent gei wai are drained in accordance with the *MPNR Management Plan 2019-2024*. The draining of the gei wai adjacent to the works areas for the tower hides effectively isolates these areas from the surrounding water bodies, there will be no possibility of any water pollution due to the Project from entering Deep Bay. Furthermore, zero contaminated runoff from works areas will be achieved through implementation of off-site pre-fabrication; off-site concrete mixing; off-site maintenance/repair of plant; taking extreme care when re-fuelling plant; covering materials, plant and equipment during rainstorms; provision of chemical toilets; bunded, covered C&D Material storage areas; and waterproof general waste receptacles. In addition, perimeter channels at site boundaries shall be provided where necessary to intercept surface runoff from outside the works areas so that it will not wash across the works areas; temporarily exposed slope surfaces shall be

covered and temporary access roads shall be protected by crushed stone or gravel; intercepting channels shall be provided to prevent storm runoff from washing across exposed soil surfaces; earthworks final surfaces shall be well compacted and the subsequent permanent work or surface protection shall be carried out immediately; and measures shall be taken to minimise the ingress of rainwater into trenches.

- **Waste.** The off-site disposal of waste shall be minimised by implementation of a WMP, segregating waste to avoid cross-contamination, transporting inert C&D Material to the PFRF at Tuen Mun Area 38, sending non-inert C&D waste to off-site recyclers, composting vegetation waste within MPNR and sending recyclable waste to local recyclers. By minimising the quantity of residual non-recyclable waste, the secondary impacts associated with handling, transportation and disposal will be reduced.
- **Ecology**. Flora and fauna will benefit from all of the above environmental protection measures and aquatic species in gei wai and the wider Deep Bay area will benefit from zero polluted run-off from construction areas. Disturbance on habitats and birds will be avoided or minimised by prohibiting noisy outdoor construction work from 16 October to 15 April each year.
- **Fisheries**. All fisheries impacts are predicted to be of low significance, hence no mitigation measures are proposed.
- **Landscape and Visual**: With full implementation of the mitigation measures as recommended in ***Section 9.7*** including responsive design of the new Tower Hides and footpaths, and implementation of bamboo screen planting at the new Tower Hides, the overall landscape and visual impacts resulting from the construction and operation of Project are all considered to be **Acceptable**, and some of the receivers may experience potentially **Beneficial** impacts from new boardwalk that is more aesthetically compatible with the surrounding natural landscapes.

11.2 Summary of Environmental Impacts

11.2.1 ***Table 11-1***, below, summarises the environmental impacts, showing the assessment points, results of impact predictions, relevant standards or criteria, extents of exceedances predicted, impact avoidance measures considered, mitigation measures proposed and residual impacts after mitigation.

Table 11-1 Summary of Environmental Impacts

REF.	DESCRIPTION	CRITERIA	CUMULATIVE PREDICTION (MAX)				EXCEEDANCE	IMPACT AVOIDANCE	FURTHER MITIGATION	RESIDUAL IMPACT
AIR QUALITY			RSP (24HR)	RSP (ANNUAL)	FSP (24HR)	FSP (ANNUAL)				
ASR 1	Village House, Tam Kon Chau Road (Residential)	Hong Kong AQOs: **RSP (24hr):** 100µg/m^3 (9 exceedances) **RSP (Annual):** 50µg/m^3 **FSP (24hr):** 75µg/m^3 (9 exceedances) **FSP (Annual):** 35µg/m^3	The predicted background concentrations of RSP and FSP are well within the AQO limits. Given that most of the dust impacts typically associated with on-site construction have been avoided due to the off-site pre-fabrication of building elements and that the area of bare ground (for construction of the boardwalks) is also relatively small, it is not considered that dust arising from the construction stage will result in any exceedance of the AQOs				Not anticipated	• Do not remove existing concrete footpaths – leave in situ to avoid dust generation from breaking • Off-site fabrication and off-site concrete mixing reduces on-site dust generation	• Measures that are recommended in the *Air Pollution Control (Construction Dust) Regulation* • Regular watering to reduce dust emissions from exposed site surfaces and unpaved roads, particularly during dry weather • Open stockpiles shall be avoided or covered. Where possible, prevent placing dusty materials storage piles near ASRs. • Side enclosure of any aggregate or dusty material storage piles to reduce emissions. Where this is not practicable owing to frequent usage, spraying with water shall be carried out • Tarpaulin covering of all dusty vehicle loads transported to and from the Site • Use of water sprinklers at the loading area where dust generation is likely during the loading process of loose material, particularly in dry weather • Imposition of speed controls for vehicles within the Site • Establishment and use of vehicle wheel and body washing facilities at the exit of the Site to minimise the fugitive dust emissions generated • Site layout should be carefully planned such that machinery and dust causing activities (e.g. haul roads and stockpiling areas) could be located away from the ASR as far as possible • Where possible, routing of vehicles and positioning of construction plant should be at the maximum possible distance from ASRs • Solid screens are recommended to be erected around any dusty construction activities	Nil
ASR 2	Occupied Container, Tam Kon Chau Road (Residential)						Not anticipated			Nil
ASR 3	Village House, Boundary Road (Residential)						Not anticipated			Nil
ASR 4	Village House, Off Tam Kon Chau Road (Residential)						Not anticipated			Nil
ASR 5	Village House/AFCD Nature Warden Office (Residential/Office)						Not anticipated			Nil
ASR 6	House 43, Lychee Road West, Fairview Park (Residential)						Not anticipated			Nil
ASR 7	House 1, Lychee Road South, Fairview Park (Residential)						Not anticipated			Nil
ASR 8	House 1, Bauhinia Road West, Fairview Park (Residential)						Not anticipated			Nil
ASR 9	House 89, Bauhinia Road West, Fairview Park (Residential)						Not anticipated			Nil
ASR 10	House 183, Bauhinia Road West, Fairview Park (Residential)						Not anticipated			Nil
ASR 11	House 2, Ficus Road, Palm Springs (Residential)						Not anticipated			Nil
ASR 12	Yeung's Fish Farm (Office)						Not anticipated			Nil
ASR 13	Peter Scott Field Study Centre, Tam Kon Chau Road						Not anticipated			Nil
NOISE			UNMITIGATED SCENARIO							
NSR 1	Village House, Tam Kon Chau Road	EIAO-TM Table 1B: **Noise Level Leq(30 min):** 75dB(A)	50 – 58				Nil	• Do not remove existing concrete footpaths – leave in situ to avoid noise generation from breaking • Off-site fabrication and off-site concrete mixing reduces on-site noise generation	• Adopting the *Code of Practice on Good Management Practice to Prevent Violation of the NCO (for Construction Industry)* published by EPD • Before commencing any work, the Contractor shall submit to the Project Engineer for approval the method of working, equipment and noise mitigation measures intended to be used at the Site • Devise and execute working methods to minimise the noise impact on the surrounding sensitive uses, and provide experienced personnel with suitable training to ensure that those methods are implemented • PME should be kept to a minimum and the parallel use of noisy equipment/machinery should be avoided • Turning off unused equipment • Regular maintenance (off-site) of all plant and equipment	Nil
NSR 2	Occupied Container, Tam Kon Chau Road		54 – 60				Nil			Nil
NSR 3	Village House, Boundary Road		56 – 61				Nil			Nil
NSR 4	Village House, Off Tam Kon Chau Road		56 – 61				Nil			Nil
NSR 5	Village House, Near AFCD Nature Warden Office		66 – 68				Nil			Nil
NSR 6	House 43, Lychee Road West, Fairview Park		49 – 57				Nil			Nil
NSR 7	House 1, Lychee Road South, Fairview Park		50 – 57				Nil			Nil
NSR 8	House 1, Bauhinia Road West, Fairview Park		48 – 56				Nil			Nil

REF.	DESCRIPTION	CRITERIA	CUMULATIVE PREDICTION (MAX)	EXCEEDANCE	IMPACT AVOIDANCE	FURTHER MITIGATION	RESIDUAL IMPACT
NSR 9	House 99, Bauhinia Road West, Fairview Park		45 – 54	Nil			Nil
NSR 10	Peter Scott Field Study Centre, Tam Kon Chau Road	**Noise Level Leq(30 min):** 70dB(A)	53 – 59	Nil			Nil
WATER QUALITY							
Gei wai adjacent to works areas and Deep Bay WCZ	N/A	WQOs for Deep Bay WCZ	No increase above ambient conditions	Nil	• Zero polluted run-off will be achieved by: • Off-site Pre-fabrication • Off-site Concrete Mixing • Off-site Maintenance/Repair of Plant • Extreme Care When Re-fuelling Plant • Covering Materials, Plant and Equipment During Rainstorms • Provision of Chemical Toilets • Bunded, Covered C&D Material Storage Areas • Waterproof General Waste • In addition, by draining gei wais 7, 8a, 19 and 20e before start of foundation works for TH2 and TH3, full hydraulic isolation is achieved and therefore zero impact on other gei wais or Deep Bay WCZ.	• As a precautionary measure and to demonstrate that the "Zero Water Pollution" approach is working, it is proposed to carry out water quality EM&A within Deep Bay before, during and after the foundation works at TH2 and TH3.	Nil
WASTE							
TH2, TH3 and Footpaths	N/A	N/A	• Inert C&D Material: 96.0 tonnes • C&D Waste (non-inert): 13.1 tonnes • C&D Waste (vegetation): 157.6 tonnes • General Refuse: 13.6 tonnes	N/A	• PFRF at Tuen Mun Area 38 • Segregation + off-site recycling by local recyclers • Composting within MPNR. • Segregation + off-site recycling by local recyclers • 9.3 tonnes of C&D waste and 9.7 tonnes of general refuse to be properly disposed of at landfill	• Implementation of a WMP • Segregating waste to avoid cross-contamination • Practice Note for Registered Contractors No. 17 Control of Environmental Nuisance from Construction Sites shall be adopted • C&D Material shall be delivered to the appropriate designated outlets by dump trucks fitted with covered box type dump bed and such dump trunks shall comply with the particular specification listed in Part B of Annex 2 to Appendix C of ETWB TC(W) No. 19/2005 • Refuse pending removal should be stored in receptacles provided with close fitting covers • A trip-ticket system shall be established as per DevB TC(W) No. 6/2010 and the Waste Disposal (Charges for Disposal of Construction Waste) Regulation	Nil
ECOLOGY							
TH2, TH3 and Footpaths	N/A	The works at Mai Po are aligned to AFCD's *Mai Po Inner Deep Bay Ramsar Site Management Plan 2011*, which requires that no outdoor work is carried out from October to April each year.	N/A	N/A	• No noisy outdoor construction work will be permitted within MPNR from 16 October to 15 April each year • Do not remove existing concrete footpaths – leave in situ to avoid noise generation from breaking • Off-site fabrication and off-site concrete mixing reduces on-site noise generation	Nil	Nil

REF.	DESCRIPTION	CRITERIA	CUMULATIVE PREDICTION (MAX)	EXCEEDANCE	IMPACT AVOIDANCE	FURTHER MITIGATION	RESIDUAL IMPACT
FISHERIES							
Commercial fisheries adjacent to the Project Site	N/A	EIAO-TM Annex 9	Low significance	Nil	• Mitigation measures proposed to control dust, water pollution and waste generation • The two new tower hides will not be provided with toilets or washrooms	Nil	Nil
LANDSCAPE AND VISUAL							
LANDSCAPE RESOURCES (LRs)							
LR1-1	Mangrove	EIAO-TM Annex 10 & 18; EIAO GN No. 8/2010	Insubstantial	Nil	• Avoid felling/ pruning of existing trees • No night time lighting for construction works • Avoid use of contrasting colour/ reflective materials for the design of building façades	• Preservation and protection of existing trees and vegetation • Arrangement of storage of construction materials • Erection of screen hoardings for the Tower Hides (where appropriate, with surface treatment/ colour suitable to the rural context) • Responsive design of the Tower Hides and Footpaths to fit in well with the surrounding natural landscapes • Bamboo screen planting at the new access to the Tower Hides to soften the outlook of hard elements	Acceptable
LR1-2	Brackish Marsh		Insubstantial	Nil			Acceptable
LR1-3	Wooded Area		Insubstantial	Nil			Acceptable
LR2-1	Brackish gei wai		Moderate	Nil			Acceptable with Mitigation
LR2-2	Rain-fed Pond		Moderate	Nil			Acceptable with Mitigation
LR2-3	Commercial Fishpond		Insubstantial	Nil			Acceptable
LR2-4	Channelised Watercourse		Insubstantial	Nil			Acceptable
LR2-5	Watercourse		Insubstantial	Nil			Acceptable
LR3-1	Developed Area		Slight	Nil			Acceptable (potentially Beneficial) with Mitigation
LANDSCAPE CHARACTER AREAS (LCAs)							
LCA1	Comprehensive Residential Development Area		Insubstantial	Nil			Acceptable
LCA2	Inter-tidal Coast Landscape		Insubstantial	Nil			Acceptable
LCA3	Offshore Water Landscape		Insubstantial	Nil			Acceptable
LCA4	Rural Coastal Plain Landscape		Slight	Nil			Acceptable
VISUALLY SENSITIVE RECEIVERS (VSRs)							
F-1	Commercial Fishpond		Insubstantial	Nil			Acceptable
F-2	MPEC		Insubstantial	Nil			Acceptable
F-3	Along Pond Bund of MPNR (near gei wai No. 20)		Moderate	Nil			Acceptable with Mitigation
L-1	Visitors outside the Entrance of MPNR		Insubstantial	Nil			Acceptable (Beneficial)
L-2	Visitors in MPNR		Moderate	Nil			Acceptable with Mitigation
L-3	Visitors in Main Tower Hide (TH1)		Insubstantial	Nil			Acceptable
R-1	Villagers next to the Entrance of MPNR		Insubstantial	Nil			Acceptable (Beneficial)

11.3 Key Assessment Assumptions, Limitation of Assessment Methodologies, and related Prior Agreement(s) with the Director

Construction Noise Assessment

11.3.1 Pursuant to para.3.4.5 of the ESB, the noise impact assessment for the construction of the Project shall follow the detailed technical requirements given in Appendix B of the ESB. Appendix B requires the following to be agreed with the Director of Environmental Protection before commencing the assessment:

- Para.2.2.1(a) Noise Assessment Area
- Para,2.2.1(c) Representative Noise Assessment Points
- Para.2.3.1 Representative Phases of Construction

11.3.2 ***Appendix F2*** contains correspondence with the Authority regarding the above matters.

Ecological Impact Assessment

11.3.3 Pursuant to para.3.4.8 of the ESB, ecological impact assessment of the Project shall follow the detailed technical requirements given in Appendix E of the ESB. According to Appendix E, the Applicant shall examine the flora, fauna and other components of the ecological habitats within the assessment area. Specifically, the assessment shall include the following major tasks regarding survey methodologies:

- Evaluate the information collected, identify any information gap relating to the assessment of potential ecological impacts to terrestrial and aquatic environment, and determine the ecological field surveys and investigations that are needed for a comprehensive assessment.
- Carry out any necessary ecological field surveys with a duration of a least 12 months covering both wet and dry seasons, and investigations to verify the information collected and fill in the information gaps identified. The field surveys shall cover flora, fauna and any other habitats/species of conservation importance, and shall include surveys for intertidal/benthic communities.

Fisheries Impact Assessment

11.3.4 Pursuant to para.3.4.9 of the ESB, fisheries impact assessment of the Project shall follow the detailed technical requirements given in Appendix F of the ESB. According to Appendix F, existing information regarding the assessment area shall be reviewed. Based on the review results, the assessment shall identify data gap and determine if there is any need for field surveys to collect adequate and updated baseline information.

11.3.5 To supplement literature review, site visits were undertaken to investigate actual fisheries status within the Assessment Area between January and November 2017. Activities related to fisheries observed during other field surveys were also recorded. The investigation of pond status within the Assessment Area is considered straight forward.

11.3.6 Summary of key assessment assumptions and limitation of assessment methodologies are listed in ***Table 11-2***, below.

Table 11-2 Summary of Key Assessment Assumptions and Limitation of Assessment Methodologies

ASSESSMENT METHODOLOGY	KEY ASSESSMENT ASSUMPTIONS	LIMITATIONS OF ASSESSMENT METHODOLOGIES / ASSUMPTIONS	PRIOR AGREEMENTS WITH EPD / OTHER AUTHORITIES		PROPOSED ALTERNATIVE ASSESSMENT TOOLS / ASSUMPTIONS (IF APPLICABLE)
			EIA STUDY BRIEF (ESB-301/2017) CLAUSE REFERENCE	RELEVANT DOCUMENTATION	
AIR QUALITY					
CONSTRUCTION PHASE					
The air quality impact assessment for the Project was conducted following Annex 4 and Annex 12 of the EIAO-TM and requirements from the EIA Study Brief (ESB-301/2017) Qualitative assessment was conducted for the air quality impact during the construction phase	• The construction works would be of small-scale and short duration Limited vehicle movement and well planned routing of vehicles within the Site, together with the use of off-site pre-fabrication will be carried out	N/A	N/A	N/A	N/A
NOISE					
CONSTRUCTION PHASE					
The noise impact assessment for the Project was conducted following Annex 5 and Annex 13 of the EIAO-TM, the requirement in the EIA Study Brief (ESB-301/2017) and Technical Memorandum on Noise from Construction Works other than Percussive Piling (GW-TM) under the Noise Control Ordinance Quantitative assessment was conducted to predict the construction noise impact	• Construction noise impact was predicted based on standard acoustic principles Sound Power Levels (SWLs) of powered mechanical equipment (PME) make reference to Table 3 of the GW-TM, EPD's Sound power levels of other commonly used PME, Quality Powered Mechanical Equipment (QPME) available at EPD's website, and other similar studies or from measurements taken at other sites in Hong Kong • Notional source position has been adopted for each work area with respect to each NSR PME were assumed to be located at the notional source of the works sites • For construction of new tower hides involving two working phases, Phase 1 with a larger site area has been used to determine the notional source position as this will give the shortest distance to NSRs, which is the more conservative approach	The construction programme and plant inventory were indicative and subject to contractors' actual operation	Clause 345 and 221 & 231 of Appendix B	Correspondence with the Authority on Construction Noise Assessment.	N/A
WATER QUALITY					
CONSTRUCTION PHASE					
The water quality impact assessment for the Project was conducted following Annex 6 and Annex 14 of the EIAO-TM and the requirement in the EIA Study Brief (ESB-301/2017) Qualitative assessment was conducted for the water quality impact during the construction phase	The construction of footings/substructure at TH2 and TH3 only when the adjacent gei wai are drained in accordance with the *MPNR Management Plan 2019-2024*	N/A	N/A	N/A	N/A
OPERATION PHASE					
The water quality impact assessment for the Project was conducted following Annex 6 and Annex 14 of the EIAO-TM and the requirement in the EIA Study Brief (ESB-301/2017) Qualitative assessment was conducted for the water quality impact during the operation phase	The two new tower hides will not be provided with toilets or washrooms	N/A	N/A	N/A	N/A

ASSESSMENT METHODOLOGY	KEY ASSESSMENT ASSUMPTIONS	LIMITATIONS OF ASSESSMENT METHODOLOGIES / ASSUMPTIONS	PRIOR AGREEMENTS WITH EPD / OTHER AUTHORITIES		PROPOSED ALTERNATIVE ASSESSMENT TOOLS / ASSUMPTIONS (IF APPLICABLE)
			EIA STUDY BRIEF (ESB-301/2017) CLAUSE REFERENCE	RELEVANT DOCUMENTATION	
WASTE MANAGEMENT					
CONSTRUCTION PHASE					
The waste management implication assessment for the Project was conducted following Annexes 7 and 15 of the EIAO-TM and the requirements in the EIA Study Brief (ESB-301/2017)	Waste quantities to be generated from the Project were estimated based on the engineering assessment and Project design	N/A	N/A	N/A	N/A
OPERATION PHASE					
The waste management implication assessment for the Project was conducted following Annexes 7 and 15 of the EIAO-TM and the requirements in the EIA Study Brief (ESB-301/2017)	No waste receptacles are provided within MPNR	N/A	N/A	N/A	N/A
ECOLOGY					
The ecological impact assessment for the project was conducted following Annex 8 and 16 of the EIAO-TM for the criteria, general approach and methodology for assessment of ecological impacts; EIAO Guidance Note No 6/2010, 7/2010 and 10/2010 for general guidelines and methodology for conducting ecological assessment and ecological baseline survey; and the requirement in the EIA Study Brief (ESB-301/2017)	The ecological assessment and evaluation were undertaken based on results of baseline and literature review, and ecological surveys The assessment includes the following major tasks regarding survey methodologies: Evaluate the information collected, identify any information gap relating to the assessment of potential ecological impacts to terrestrial and aquatic environment, and determine the ecological field surveys and investigations that are needed for a comprehensive assessment Carry out any necessary ecological field surveys with a duration of a least 12 months covering both wet and dry seasons, and investigations to verify the information collected and fill in the information gaps identified The field surveys shall cover flora, fauna and any other habitats/species of conservation importance, and shall include surveys for intertidal/benthic communities	N/A	N/A	N/A	N/A
FISHERIES					
The fisheries impact assessment for the Project was conducted following Annexes 9 and 17 of the EIAO-TM and the requirements in the EIA Study Brief (ESB-301/2017)	The fisheries impact assessment was undertaken based on results of literature review and field surveys	N/A	N/A	N/A	N/A
LANDSCAPE AND VISUAL					
The landscape and visual impact assessment was prepared in accordance with Annexes 10 and 18 of the TM and EIAO Guidance Note No 8/2010 and the requirement in the EIA Study Brief (ESB-301/2017)	In view of the limited scale of the Project, which comprises new boardwalk and low-rise buildings (proposed Tower Hides), the VIA for the purposes of this EIA only focuses on local VSRs and the Assessment Area for VIA is defined by the primary ZVI within which the Project can be viewed by local VSRs	N/A	N/A	N/A	N/A

11.4 Summary of Alternative Options and Mitigation Measures

Initial Development Option

11.4.1 Within the Project Site one or more of the following were initially proposed in the Project Profile that was prepared in July 2017:

1. Refurbishment of MPEC – included internal refurbishment and construction of external FS Water Tank and Pump Room
2. Widening of the Existing Footpath – removal of existing concrete footpath and replacement with a wider concrete footpath
3. Construction of New TH2 – a new three-storey tower hide
4. Expansion of Existing TH1 – renovation of existing TH1 and an extension building
5. Construction of New TH3 – a new three-storey tower hide
6. Construction of New "Circular Route" Footpath – construction of a new concrete footpath connecting to New TH3

11.4.2 All of the above were DPs due to being located within the SSSI. At the time the Project Profile was submitted, the Project Proponent could not confirm which of these components would be implemented – clearly, EITHER Expansion of TH1 OR Construction of New TH3 would be carried out, but not both.

Revised Development Option

11.4.3 During the public inspection period for the Project Profile, a number of comments were received from green NGOs. One of the key comments related to the provision of the "Circular Route" as a concrete footpath and the suggestion that to minimise environmental impacts, a boardwalk design should be considered. Another comment related to need for concrete mixing on-site and the environmental impacts associated with this.

11.4.4 In response to these concerns, to mitigate the environmental impacts and to address other design issues, a Revised Development Option was prepared:

1. Refurbishment of the Mai Po Education Centre – included internal refurbishment and construction of external FS Water Tank and Pump Room.
2. Widening of the Existing Footpath – removal of existing concrete footpath and replacement with a wider concrete footpath, with the addition of EAs.
3. Construction of New TH2 – a new three-storey tower hide, with off-site prefabrication of components and no concrete-mixing on-site.
4. Expansion of Existing TH1 – renovation of existing TH1 and an extension building, with off-site prefabrication of components and no concrete-mixing on-site.
5. Construction of New TH3 – a new four-storey tower hide, with off-site prefabrication of components and no concrete-mixing on-site.
6. Construction of New "Circular Route" Footpath – construction of a new wooden boardwalk above gei wai Nos. 6 and 7.

11.4.5 The key improvements to the design were changing the "Circular Route" Footpath from a concrete design to a boardwalk above the gei wai and changing its alignment from straight, parallel to the existing footpath, to a meandering route. Also off-site pre-fabrication of components and no concrete mixing on-site.

Preferred Development Option

11.4.6 Initial environmental assessments indicated that dust and noise levels due to mechanical breaking of existing concrete when removing the footpaths could give rise to adverse environmental and ecological impacts. For this reason, it was decided to install boardwalks above the existing concrete footpaths, leaving them in situ and untouched.

11.4.7 It was always intended to EITHER Expand TH1 OR Construct a New THIE. As the design progressed, it was revealed that the foundations required to expand TH1 would severely impact a nearby tree and likely cause its death. Subsequently, the results of the ground investigation indicated that the site for TH1E was satisfactory. It was therefore decided to delete the Expansion of TH1 and also to rename TH1E as TH3 for consistency.

11.4.8 Even with the boardwalk design for the "Circular Route", there would still be a loss of mangrove. Furthermore, initial ecological assessment and discussions with the Authority indicated that the presence of the boardwalk above the gei wai and the physical presence of supporting posts in the gei wai would constitute a loss of wetland habitat in terms of area, although not a loss of wetland function. As such, the "Circular Route" was deleted.

11.4.9 The Project now comprised the following Elements:

1. Construction of New TH2
2. Construction of New TH3
3. Construction of New Boardwalks
    a. above existing paths
    b. for EAs

11.5 Documentation of Public Concerns

11.5.1 ***Appendix G*** documents concerns raised by the general public, special interest groups and relevant statutory/advisory bodies – by letter, email, etc. – and the responses from the Project Proponent. The following sections summarise the concerns raised by stakeholders and how these concerns were addressed by the Project Proponent through changes to the Project scope, as described in this EIA Report.

11.5.2 Stakeholders engaged by the Project Proponent include:

- Conservancy Association
- Designing Hong Kong
- Green Power
- Hong Kong Birdwatching Society
- Kadoorie Farm and Botanic Gardens
- Prominent individuals in the field of conservation/environmental protection
- Relevant government departments and bureaux

First Round Consultation (July 2017)

11.5.3 The Project Profile was made available for public inspection on 14 July 2017 as part of the EIA process. A number of comments were received from green groups regarding the scope of the Project as it was envisaged at that time.

11.5.4 WWF arranged to meet with those stakeholders who provided comments in order to provide further information, obtain additional feedback and to answer questions. Meetings were held with stakeholders on 25 July 2017, with follow-up discussions extending into August 2017 (see ***Appendix G1***).

11.5.5 WWF took these comments seriously and as a result, a number of changes were made to the Project, which have been discussed in ***Section 2.3***, and which culminated in the Preferred Development Option that has been assessed in this report.

- **General Comments.** Lack of information in the Project Profile was a common concern, with some stakeholders asking for detailed assessments. The Project Proponent advised that detailed information would be included in the EIA Report.
- **Widening of Existing Footpath.** Queries were raised regarding the use of the widened footpath by vehicles and damage to wetland and felling of trees. The Project Proponent responded that the new boardwalk will be for pedestrians only, it will not encroach on wetland nor will any trees be felled.

- **The New "Circular Route" Footpath.** Originally proposed as a concrete footpath, stakeholders questioned the construction method, its impact on the gei wai that the Circular Route would cross, and the need for it. The Project Proponent confirmed the need and agreed to change from concrete path to a boardwalk. Subsequently, after further consideration by the Project Proponent, the Circular Route was deleted from the Project.
- **Expansion of Existing TH1 and Construction of New TH3.** There was confusion regarding the need to carry out both of these works. The Project Proponent clarified that only one of these two works would be needed, and that the preference was for Construction of New TH3.
- **Construction of New TH2.** Stakeholders requested justification on the site selection for TH2 and how it would be accessed. The Project Proponent explained that justification for the siting of TH2 would be provided in the EIA Study and explained how it would be accessed.
- **Demolition and Rebuild of PSFSC.** Although PSFSC was not mentioned in the Project Profile as a DP (only as concurrent project), most stakeholders said it should be included in the EIA Study. The Project Proponent agreed that PSFSC was an integral part of the MPNR Infrastructure Upgrade Project but because it is not in itself a DP, then it should not be included in the actual EIA Study (other than as a concurrent project). On this basis, the Project Proponent intends to provide a detailed Environmental and Ecological Assessment (EEA) of the works at PSFSC as an appendix to the EIA Study. *[Update: The detailed EEA was released to the public in May 2019, prior to the start of demolition works. Due to changes in construction programme, work on the MPNR Infrastructure Upgrade Project will now not start until after the rebuild of PSFSC has been completed. As such, PSFSC will no longer be a concurrent project (instead, an ASR and NSR) and so the EEA is not included as appendix to this EIA. The EEA for PSFSC is, however, available to download from the WWF website.*
- **Increase in Visitor Numbers.** Some stakeholders were concerned about impacts of a larger number of visitors at MPNR in the future. The Project Proponent explained that "visitor hours" (i.e. the amount of time spent within MPNR) rather than simple visitor numbers is the most appropriate metric to determine operational impact. Visitor hours would be reduced in the future thanks to the new infrastructure, which would to a large extent offset impacts from more visitors.
- **Which Components will be Constructed.** Some stakeholders were concerned that the "worst case scenario" to be assessed in the EIA Study would mean that the "worst case" could actually be constructed. The Project Proponent advised that since the Project Profile was published, the design of the Project had evolved and a number of components, such as the Circular Route and External Works at MPEC, had been removed from the Project scope.
- **Marine Ecological Impacts/Fisheries Impact/Survey Species Other than Birds.** The Project Proponent explained that marine ecological impacts (either in gei wai or Deep Bay) will be unlikely because of the exceptional care taken to avoid any construction-related contamination to gei wai. The Project Proponent confirmed that at Fisheries Impact Assessment would be carried out and that a 12 months ecological survey of covers mammals (including bats), herpetofauna, odonates, butterflies, fireflies, and aquatic fish, not just birds, would be carried out.

Second Round Consultation (December 2017)

11.5.6 The second round of consultation was carried out on 14 December 2017, with follow-up discussions extending in February 2018 (see ***Appendix G2***). Updated information about the Project was provided to stakeholders. The key discussions were:

- **Need for Tower Hide TH3.** Stakeholders continued to question the need for the new TH3. The Project Proponent justified the need by explaining the overcrowding currently experienced by school classes in the adjacent TH1, which is not large enough to accommodate more than one class. The situation of inadequate space is aggravated when birdwatchers and/or photographers are in the hide with a class.

- **Location of Tower Hide TH2.** Stakeholders questioned the location of TH2, asking if the location was only chosen because that is where an old canvas hide used to be. The Project Proponent explained that the southern part of the reserve has most of the freshwater habitats and is a regular spot for the eagles in the winter. The location chosen immediately faces pond 20, the three-storey structure will provide a good general view of the southern ponds and is selected being close to the existing footpath between GW18/19 so that users do not need to venture deep into the southern part of the reserve.
- **Use of MPEC and PSFSC.** MPEC was previously included in the Project Profile when there were going to be external works carried out. It was later decided not to go ahead with these external works and so MPEC is no longer a DP. The only works at MPEC will be internal redecoration. The Project Proponent said that works at PSFSC was justified is fully explained as not being a DP.
- **Inclusion of PSFSC in the EIA Study and Planning Application.** Stakeholders again wanted PSFSC to be included in the EIA Study and the Planning Application. The Project Proponent again explained that PSFSC is not a DP and does not require planning approval, but said that a detailed EEA of the works at PSFSC would be included as an appendix in the EIA Report. The EIA Report relates to DPs, which is why assessment of PSFSC is not included in the main body of the EIA. *[Update: Please see 6th bullet under First Round Consultation, above.]*
- **Increased Disturbance due to Increased Visitor Numbers.** Stakeholders were concerned about the adverse impact of wildlife of an increased number of 32,000 visitors per year targeted after completion of the Project, compared to the present 24,000 per year. The Project Proponent explained that from 1993 to 2004, the number of visitors hovered at a peak of between 35,000 and 45,000 per year until the Wetland Park opened and numbers declined. During this period water birds using Mai Po and Deep Bay, including Black-faced Spoonbill, were not affected by visitors. As such, no adverse impacts are expected in the future.
- **Traffic Impacts.** The Project Proponent explained that parking spaces for private cars and coaches would be provided at PSFSC and that a TIA had been carried out, which indicated no adverse impacts. However, the Project Proponent was also exploring the provision of shuttle bus services with links to public transport or nearby parking and intends to promote environmentally friendly transport, rather than private vehicles.
- **Marine Ecological Impacts.** Stakeholders were concerned about the impacts to the marine environment, which they said included the gei wai and also Deep Bay. The Project Proponent explained that the foundation works for the Tower Hides would be carried out when adjacent gei wai would be drained (as part of the normal management of MPNR) and so there could not be any water pollution from the construction works.
- **Mai Po Sesarmine Crab.** There was a discussion between stakeholders who believed that the Mai Po Sesarmine Crab was present, or could be present in the future. The Project Proponent maintained that the gei wai and bund habitat was unsuitable for the Crab and that none had been found in MPNR, either in past surveys or during the 12 months ecological survey carried out for this Project. In any case, if the Crab was present, it would not be affected by the works, since the mangroves in the gei wai are not affected by the Project.
- **Barrier Effect.** Some stakeholders believed that the new boardwalks and screening around the Tower Hides would act as a barrier to some fauna species. The Project Proponent noted that the existing screens around TH1 did not seem to adversely affect wildlife. In fact, many mammals within MPNR use the footpaths to move around. Subsequently the Project Proponent decided to elevate the new boardwalks and screens by a few centimetres to allow smaller animals to pass beneath, while at the same time allowing larger animals to walk over the top (of the boardwalks).

Third Round Consultation (June 2018)

11.5.7 The third round of stakeholder consultation was carried out between 11 and 15 June 2018 and involved green NGOs as well as relevant government departments/bureaux (see ***Appendix G3***).

11.5.8 Based on the latest Project information provided to the stakeholders, the feedback was largely positive. The key discussions relating to environmental issues were:

- **Internal Renovation Works at EC.** Since the EC was mentioned in the EIAO Project Profile, a stakeholder suggested that the Project Proponent may have to wait until the EIA was approved before starting work on the renovation or resubmit the Project Profile. On 12 December 2017, the Project Proponent explained that the refurbishment works stated in the Project Profile (i.e. the internal renovation and the new external fire services structures) were deleted from the Project; and provided further clarification on 21 March 2018. The Authority agreed on 11 April 2018 that the Project Profile remained valid for the present scope. The internal renovation works are not a DP and the laying of the new power line is also not a DP. Thus, the starting of the renovation works at EC shall not be restricted by the approval of the EIA. A stakeholder also wished to know how the public would be informed about the start date and duration of the renovation works EC. The Project Proponent advised that the tenders had not yet been awarded but it is expected that a notice could be issued in July 2018. The internal renovation works at EC began in September 2018 and finished in September 2020.
- **Septic Tank and Soakaway Pit System at EC.** The Project Proponent advised a stakeholder that since the EC was principally for school visits and there would only be a marginal 10% increase in the number of school visits forecast at the EC after renovation, this was still within the design capacity of the current system. A survey had been conducted and the system was still working perfectly.
- **Operational Expenses (OPEX) for Tower Hides and Footpath.** A stakeholder was concerned about the OPEX for the Tower Hides and Footpath given the materials being considered. The Project Proponent advised that financial modelling would be carried out to take OPEX into consideration and had started setting aside contingency funds to cater for any increase in OPEX.
- **Minimum Gap Below Screening and Boardwalk of 6cm.** The Project Proponent has suggested raising the base of the screening along Tower Hide access paths and the base of the Boardwalks 6cm off the ground to allow small animals to pass beneath. A stakeholder was not convinced that this was the correct gap but did not suggest any other, and also suggested if animals always followed the same route, then underpasses could be provided at appropriate locations. However, another stakeholder did not think there were any set routes. The size of gap will be kept under review by the Project Proponent.
- **Height of Tower Hides.** A stakeholder doubted that whether the need for three storeys for the Tower Hides could be justified on capacity alone. The Project Proponent explained that capacity was only one consideration and in Tower Hide 2, for example, this was not the major consideration. The major benefit of a three-storey hide was to provide sufficient elevation to allow views over a much greater area, meaning visitors would not need to go to these areas, hence less disturbance on the ground.
- **Hoardings for Footpath and Tower Hides.** A stakeholder asked about the nature of the hoardings for the Footpath and the Tower Hides. The Project Proponent advised that they would, as far as possible, control the hoardings to be minimal and largely demarcational, consisting in mesh fences or netting.
- **Works for Tower Hides.** A stakeholder queried the duration of the works, especially the footings for the Tower Hides, and the line to the Mai Po Habitat Management Plan. The Project Proponent advised that the Project will follow the Habitat Management plan as this is where the ecological priority lay and stressed that effort would be made to ensure that all the work could be finished in one bird season (six months) by greater use of pre-fabrication. It was targeted to finish the footings in two months for example.
- **Bird and Bat Roosting Boxes.** A stakeholder suggested featuring bird and bat roosting boxes in the designs of the new PSFSC and Tower Hides. The Project Proponent agreed to look into the suggestion. The Project Proponent also agreed to examine the use of solar pipes (“light pipes”) or optical fibre solutions to improve natural lighting inside the Tower Hides.

12 CONCLUSION

12.1.1 The aim of the Project is to provide a unique experience in educational recreation, groom local scientists and contribute to a greater understanding of the unique Mai Po environment through cutting-edge research in ecology. It is crucial to transform MPNR into a 21st Century Nature Classroom in order to facilitate this unique learning experience and effectively manage this important, world-class wetland ecosystem.

12.1.2 To do this, the following three infrastructure upgrades will be carried out within a six months period from mid-April to mid-October 2022 tentatively:

1. Construction of New TH2
2. Construction of New TH3
3. Construction of New Boardwalks
    a. above existing paths
    b. for EAs

12.1.3 The construction programme for the footings/substructure for TH2 and TH3 follows the planned draining of gei wai Nos. 19 and 20e and gei wai Nos. 7 and 8a, respectively, as set out in the MPNR Management Plan 2019-2024 and its updates.

Air Quality

12.1.4 A qualitative assessment of air quality impacts was carried out for the construction stage. No exceedance of AQO limits for RSP and FSP at representative ASRs is expected, and no exceedance of the EIAO-TM limits for 1-hour TSP at representative ASRs is expected. No significant increase in air quality impact at ASRs is anticipated during the construction stage. With the implementation of the recommended mitigation measures and good site practice, adverse impacts during the construction stage are not anticipated.

Noise

12.1.5 The noise impact arising from the construction of the Project at the representative off-site NSRs has been assessed. The results of the assessment indicate that noise levels at the off-site NSRs will comply with the relevant noise criteria. As such, further noise mitigation measures during construction are not necessary.

Water Quality

12.1.6 WWF will adopt a “Zero Water Pollution” approach during construction, particularly for TH2 and TH3. This relies on two key elements; the avoiding pollution of adjacent gei wai and Deep Bay; and avoiding generating polluted runoff from works areas in the first place.

12.1.7 To avoid pollution of adjacent gei wai and Deep Bay, the schedule of foundation works at TH2 and TH3 – the most potentially polluting period during construction in terms of runoff – will be aligned with the schedule of draining the adjacent gei wai in the *MPNR Management Plan 2019-2024.* The drained gei wai undergoing such maintenance are not hydraulically connected to any other gei wai nor to Deep Bay, i.e. they are fully isolated from surrounding water bodies. A perimeter bund will be constructed around the TH2 and TH3 work sites to ensure that any runoff generated from within these sites is discharged only into the adjacent drained gei wai and does not discharge into any other water-filled gei wai. With no water in the adjacent gei wai into which all site runoff will flow, it will not be possible for any contaminants from the works (which are not anticipated anyway) to flow into other gei wai or, ultimately, flow into Deep Bay.

12.1.8 To avoid generating polluted runoff from works areas in the first place, zero contaminated runoff will be achieved through implementation of a series of measures, including off-site pre-fabrication, off-site concrete mixing, off-site maintenance/repair of plant, taking extreme care when re-fuelling plant, covering materials, plant and equipment during rainstorms, provision of chemical toilets, bunded, covered construction C&D material storage areas, and waterproof general waste receptacles.

12.1.9 In addition to this, the Works Contractor shall follow good site practice and be responsible for the design construction, operation and maintenance of applicable mitigation measures specified in *ProPECC PN 1/94* for construction site drainage.

12.1.10 With the above measures in place during the construction stage, it is unlikely that there will be any adverse water quality impact to the gei wai or to Deep Bay as a result of the works. Furthermore, no cumulative impact is identified.

12.1.11 During operation, no adverse water quality impact is anticipated as the two new tower hides will not be provided with toilets or washrooms, and so no wastewater will be generated. Runoff from the roof of the tower hides and from the footpaths will not be contaminated.

12.1.12 Overall, therefore, no adverse water quality impact is anticipated during the construction or operation stages of the Project.

Waste Management

12.1.13 During construction is estimated that a total of 280.3 tonnes of waste will be generated, which equates to 93.4 tonnes per month over the three months during which construction will be carried out. This waste comprises inert C&D material, C&D waste and general refuse. Chemical waste will not be generated as WWF will mandate in all contract documents that there shall be no maintenance or repair of vehicles, plant or equipment on site. Of the 280.3 tonnes of waste generated it is anticipated that up to 261.4 tonnes could potentially be treated/recycled/ recovered, to avoid disposal at landfill, which is a 93% waste diversion rate. Provided that the recommended mitigation measures are followed, there should be no adverse waste impact from the handling, transportation or disposal of inert C&D material, C&D waste or general waste during construction.

12.1.14 During the operation, inert C&D material, C&D waste and chemical waste are not anticipated to be generated. General refuse may be generated by visitors but to minimise the amount WWF will continue to encourage visitors to bring their own reusable water bottles and food containers. No waste receptacles are provided within MPNR and visitors will be encouraged to take their waste home with them. As such there will be no general waste deposited within MPNR during operation. Outside the Project Site, recycling bins will be provided.

12.1.15 Overall, therefore, no adverse waste management implications are anticipated during the construction or operational stages of the Project.

Ecology

12.1.16 The current ecological conditions and potential ecological impacts of the proposed Project have been assessed. Based on this review, measures to avoid and minimise ecological impacts have been recommended. With these measures in place it is considered that all significant ecological impacts of the project will be addressed and residual impacts will be acceptable.

12.1.17 Overall, therefore, no adverse ecological impact is anticipated during the construction or operation stages of the Project.

Fisheries

12.1.18 There are no ponds in the Project Area and so there will be no direct impact on fisheries within the Project Area during construction. Adjacent to the Project Site are commercial fisheries. However, with the mitigation measures proposed elsewhere in this report to control dust, water pollution and waste generation, indirect impacts on fisheries due to construction activities will be insignificant. This includes the fish ponds in the vicinity of the Site and also fisheries in the wider area, including oyster farms in Deep Bay and fish culture zones elsewhere.

12.1.19 The two new tower hides will not be provided with toilets or washrooms and so no wastewater will be generated during the operations stage. Runoff from the roof of the tower hides and from the footpaths will not be contaminated. As such, there will be no point or non-point pollution sources due to the operation of the Project and therefore no impact to the water systems – fish

ponds, gei wai or Deep Bay – or associated sensitive receivers within the Project Site or within the Assessment Area for fisheries impact.

12.1.20 Overall, therefore, no adverse fisheries impacts are anticipated during the construction or operational stages of the Project.

Landscape and Visual

12.1.21 With full implementation of the recommended mitigation measures, including responsive design of the new tower hides and footpaths, and implementation of bamboo screens at the new tower hides, the overall landscape and visual impacts resulting from the construction and operation of Project are all considered to be Acceptable. Some of the receivers (e.g. LR3-1 Developed Area, and the VSRs L-1 and R-1 located outside the entrance of MPNR) may experience potentially Beneficial impacts from the upgrading of the existing paved footpath to the new wooden boardwalks, which are more aesthetically compatible with the surrounding natural landscapes.

12.1.22 No cumulative landscape and visual impacts are anticipated as no concurrent projects are identified in the 500m Assessment Area.

Environmental Monitoring and Audit

12.1.23 An EM&A programme is proposed to ensure compliance with the recommendations in the EIA study to assess the effectiveness of the recommended mitigation measures and to identify any further need for additional mitigation measures or remedial action.

12.1.24 With the implementation of the recommended mitigation measures, no adverse environmental impact from the Project is anticipated. As a precautionary measure, water quality monitoring will be carried out and regular site environmental audit is recommended to ensure the implementation of the recommended mitigation measures.

12.1.25 Regular inspection and audit of each works area shall be conducted during the construction phase of the Project to ensure the recommended mitigation measures are properly implemented. When there are ongoing construction works within the Project Site, the ET shall carry out inspections once per week and the IEC shall carry out audits jointly with the ET once every two weeks.